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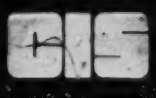

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COMPETITIVE CHALLENGE FACING U.S. INDUSTRY

HEARINGS

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDREDTH CONGRESS

FIRST SESSION

ON

COMPETITIVE CHALLENGE FACING U.S. INDUSTRIES IN THE SCIENCE, TECHNOLOGICAL, AND INDUSTRIAL FIELDS

JANUARY 20 AND FEBRUARY 24, 1987

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COMPETITIVE CHALLENGE FACING U.S. INDUSTRY

TUESDAY, JANUARY 20, 1987

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The committee met, pursuant to notice, at 9:33 a.m. in room SR-253, Russell Senate Office Building, Hon. Ernest F. Hollings (chairman of the committee) presiding.

Staff members assigned to these hearings: Pat Windham, professional staff member and Mary Pat Bierle, minority professional staff member.

OPENING STATEMENT BY THE CHAIRMAN

The CHAIRMAN. Good morning. The hearing will please come to order.

This morning the Committee on Commerce, Science, and Transportation begins its hearings for the 100th Congress with a review of the competitive challenge facing U.S. industry.

During the past few months, the word "competitiveness" has worked its way up to Chapter One/Page One of the American political lexicon. A few months ago it was drugs that were about to destroy American society. Now it's our lack of "competitiveness." Everyone's now talking about how American industries have to become more "competitive" in the world marketplace. And we now understand that even President Reagan is going to make "competitiveness" a cornerstone of his State of the Union address next week.

Apparently, it is now clear to everyone that this problem is not going to go away by itself. Each month brings more bad news and ominous statistics. In November, we ran an all time high trade deficit of $19.2 billion. The trade deficit for 1986 looks like it will hit $170 billion—and all this despite a drop of almost 40% in the value of the dollar relative to the Japanese yen.

There was a time when we thought "hi-tech" would bail us out. Six years ago we ran a $25 billion surplus in hi-tech. But that has steadily dwindled since then, and 1986 was the first year we ran a trade deficit in high-technology products.

The danger signs are all-too apparent. We're losing our industrial capacity, our jobs, and our economic muscle. We've got to set the course right, or our standard of living will follow.

My fear, however, is that this issue will suffer the fate of so many others—a few weeks on the front page and then on into oblivion.

That would be a tragedy, indeed. For the competitive challenge from abroad is one of the most pressing problems facing this nation and its future. It has been for years.

Throughout every level of the public and private sector, we need to rearrange priorities in order to respond to this challenge.

We need a more competitive budget policy in government. In the past six years we've doubled our national debt to $2 trillion. As other countries have moved in to finance our debt, we've quickly gone from the world's leading creditor to the biggest debtor nation. The world marketplace of tomorrow will be more competitive than ever, yet our children will have to face it with a mountain of debt—the result of our profligacy and mismanagement.

The Gramm-Rudman-Hollings law is designed to put the brakes on these "borrow and spend" policies. But I would hope that any discussion of "competitiveness" give responsible fiscal policy its proper due.

We also need a more competitive trade policy. I am convinced that our industries can be the most competitive in the world. But we also need a government which is ready to compete. That's not happening now. Many of our trading partners go to great lengths to subsidize home industries and protect their own markets from American competition. Yet our government just stands idly by and yells "free trade, free trade."

I'm all for expanding world trade, but at whose expense? This shirt I'm wearing can be produced in downtown Shanghai for 18-cents-an-hour, and there are more than a billion Chinese ready to work for that wage. In this country we have minimum wage, Social Security, unemployment insurance, clean air, clean water, and regulations requiring a safe workplace. Are we going to simply cast all that aside in order to compete with countries whose standards of living are decades behind ours?

One part of the solution is simple—enforce the trade laws we already have on the books. That's the very least we could do.

Finally, we need to set the tone for our industries to become more competitive in a changing world. We must find ways to improve our products and services, modernize our factories, and enable labor and management to improve performance.

Technology is important, as the President's Commission on Industrial Competitiveness concluded, because it is America's strongest comparative advantage on the world marketplace. We must seek ways to channel more of our technical know-how into commercial applications.

There are other important factors: a stronger educational system, more support for civilian research—to name a couple.

Our task this morning, and throughout this 100th Congress, is to understand the origins of these problems and to seek ways to remedy them. Today's hearing is a first step in that direction. This hearing focuses on three general topics: the nature of the competitive challenge facing this country; the ways in which government can work with business, labor, and academia to address this chal-

lenge; and the types of federal policies which can help maintain U.S. technological leadership and promote industrial success.

This Committee will not pursue heavy-handed government policies toward commerce. We do not want centralizing planning, but we do want government on the side of our companies and our workers. We do not want huge new federal bureaucracies, but we do want sound, targeted programs in technology and other areas that will help American business and labor as they strive to modernize our industry. We do not want government attempting to dictate to business and labor, but we do want to find ways in which all of us—government, business, labor, and academia—can work together to boost our industrial competitiveness and create economic opportunities for ourselves and our children. These are the tasks that will guide this Committee this morning and in the months ahead.

I believe that our Commerce Committee is well-equipped to study this issue. We have an excellent group of experienced and talented Members, from both sides of the aisle, and I very much look forward to working with my colleagues on these and other issues.

We also have a distinguished set of witnesses this morning, beginning with Senator Baucus and Senator Chafee, the two Senate co-chairmen of the new Congressional Caucus on Competitiveness. I understand that they are speaking this morning as individuals, not necessarily on behalf of the Caucus.

Dr. George Kozmetsky brings to us a unique mixture of perspectives, having been both a highly successful businessmen as well as a leading professor. He is a co-founder of Teledyne Corporation, a $2.8 billion-a-year manufacturing, oil exploration, and insurance firm. He is also former Dean of the University of Texas Graduate School of Business and currently directs that university's Institute for the Study of Innovation, Creativity, and Capitalism.

He will be joined by Howard Samuel, President of the Industrial Union Department of the AFL–CIO, and Dr. Richard Cyert, President of Carnegie-Mellon University in Pittsburgh. Along with his long and distinguished service in the labor movement, Mr. Samuel also served as Deputy Under Secretary of Labor for International Affairs during the Carter administration. Mr. Cyert is not only President of one of the nation's top technical universities but also a highly respected authority on industrial organizations.

Mr. Samuel and Dr. Cyert are both members of the Executive Committee of the Council on Competitiveness—a private, non-profit organization established to promote U.S. competitiveness. The new Council is chaired by John Young, who served as Chairman of the President's Commission on Industrial Competitiveness. Mr. Samuel served on that important commission. Today Mr. Samuel and Dr. Cyert are expressing their own views and not necessarily those of the full Council on Competitiveness.

I look forward to hearing the views of our witnesses and to learning more about how we can turn this situation around.

Senator Gore do you have a statement?

OPENING STATEMENT BY SENATOR GORE

Senator GORE. Mr. Chairman, I want to congratulate you on promptly bringing before this Committee an issue which promises to dominate debate in the 100th Congress. Why is the competitive position in the world economy eroding and what can we do about it?

It is clear that the competitive position of U.S. industry has been eroding for the last 15 years, or longer, and that it shows no signs of improvement. Several years ago I served as Chairman of the Congressional Clearinghouse on the Future. The studies that we conducted made clear that American industry was headed for troubled water, indeed, that we had been sailing in it for some time, and that drastic changes in relationships among business, government, and labor would be necessary to survive in world competition in the 21st century.

Unfortunately, too few of these needed fundamental changes have taken place. Instead, the monetary and fiscal policies of the eighties have exacerbated an already dangerous trend. The erosion has continued, not only in the steel and automobile industries, but in those upon which the future competitive base of American industry depends, many of which seemed to have a bright future a decade ago: telecommunications, semiconductors, robots, fiber optics, machine tools, civilian aviation, electronics, and, more recently, even in service industries such as banking and finance.

While fiscal and monetary policy hastened the decline, it has become clear that improvement in those areas alone will not automatically rejuvenate American competitiveness in the world economy. And just as we cannot look only to the declining value of the dollar to improve the competitive advantage of American goods and services, we cannot expect a more aggressive trade policy to solve fundamental problems of competitiveness in American society. Indeed, while we must continue to use every means to ensure that we face our competition on that ever elusive level playing field, it is abundantly clear that simple protectionism will result in an even steeper decline in American productivity and ability to compete in world markets.

Many of the problems that are part of the competitiveness dilemma are not fundamentally economic. They would be better described by a cultural anthropologist than an economist. The problems will not yield to quick fixes from Washington or from the corporate boardrooms. Rather the solutions must be worked out carefully with constant efforts to build national consensus. As the Young Commission pointed out, policymakers frequently operate without a commonly accepted set of facts or a shared understanding of the tradeoffs required by various policy options. The changes that will be required in the role of government, the nature of the corporation, the place of nations in the world economy, and in the basic notions of rights and duties in the American society are too fundamental and complex to be accomplished without some degree of consensus—at the very least on the definition of the basic problems we face. We may always disagree—perhaps in our society we should always disagree—on the solutions, but we must strive to

find a shared understanding of the problems and not continue to sail blindly in the storm.

These hearings are an important first step in this process.

The CHAIRMAN. We are pleased this morning to lead off with our distinguished colleague from Montana, Senator Baucus.

I was also awaiting Senator Chafee, your Co-Chair for your Competitiveness Caucus, but in any event we welcome you and we would be delighted to hear from you at this time.

STATEMENT OF HON. MAX BAUCUS, U.S. SENATOR FROM MONTANA

Senator BAUCUS. In the interest of efficiency, Mr. Chairman, I will proceed. I am sure Senator Chafee will be here any moment, but we might as well get started here.

Mr. Chairman, let me begin by congratulating you on holding these hearings. I think this issue, international competitiveness, is the most important issue facing this Congress. That is why, Mr. Chairman, as you mentioned, Senator Chafee and I have formed the Competitiveness Caucus, a bicameral, bipartisan group here in the Congress to tackle competitiveness.

I think the Congress is going to focus on this issue this year. In fact, Mr. Chairman, the Caucus that we have formed is already quite large. It now numbers over 160 members in both bodies, which I think reflects the growing concern over our country's declining competitive position.

In my judgment, we cannot pay too much attention to this issue. I think our country is beginning to recognize this. The President is likely to emphasize U.S. competitiveness in the State of the Union address later on this week.

The 1988 presidential candidates from both parties are beginning to stress this issue, and many committees in Congress are also seeking solutions. In fact, I believe that when the history of the Congress is written, they will call this 100th Congress the "competitiveness Congress."

So I would like to spend just a few minutes this morning defining the competitiveness crisis and suggesting what I think we must do to win.

Mr. Chairman, we have all heard of the gender gap, we have heard of the generation gap. But in this country today we face a terrible competitiveness gap. Between 1960 and 1985, productivity in the United States increased an average annual rate of 2.7 percent. Japan's average annual growth rate during that same period was not 2.7 percent, but 8 percent.

The United Kingdom, which some regard as an empire in decline, had an increase of 3.6 percent, about one-third more than the average annual growth rate in the United States.

Those are not just abstract figures. Lagging productivity means a real cut in our standard of living. Today the median income of the average American family is the same as it was in 1965. Let me repeat. The median income of an average American family today is the same as it was in 1965. That is not progress.

There are many things this committee can do. We are falling seriously behind other nations in science and technology. If we ever

needed a reminder that we are falling behind in that area, it was provided by a recent report that between 1961 and 1985, the share of foreign patents granted in the United States skyrocketed from 11 percent to 44 percent.

This committee can and should address our science and technology slippage. Last year, Senator Rockefeller and I introduced the Japanese Technical Literature Act which provided for the translation of Japanese technical literature so that our scientists and engineers can benefit from Japanese discoveries. This committee reported that bill favorably and eventually saw it enacted.

This committee can play an extremely important role in this type of legislation. But I want to stress today that the competitiveness gap cannot be overcome with one bill. Competitiveness is competition, and competition is process—not a bill. We must create a process, an attitude, in which competitiveness considerations are an integral part of U.S. policymaking.

I like to compare it with the environmental movement. In the 1940s and 1950s the environment was not taken into consideration in making policy. In the 1960s and 1970s we made it a top priority. No single bill, whether it was NEPA or the Clean Water Act, solved the problem. Instead, improvement came through a change in attitude and consistently applied pressure in favor of preserving our environment. Legislation was critical, but it was a fundamental change in attitude and approach that has led to legislation, plus a myriad of other actions that have left us the legacy of a cleaner environment today.

We must take the same approach to competitiveness. We must effect a fundamental change in attitude that makes us face up to the competitiveness threat we face today. We cannot do it overnight. It took us 30 years to get into this mess. It will take many years to get out of. But as the poet said, "A journey of a thousand miles begins with a single step."

Mr. Chairman, I congratulate you on taking one of the first steps of that journey by holding these hearings. I look forward to working with this committee and shaping a more competitive United States of America.

Thank you.

The CHAIRMAN. Well, we thank you.

Senator Chafee.

STATEMENT OF HON. JOHN H. CHAFEE, U.S. SENATOR FROM RHODE ISLAND

Senator CHAFEE. Thank you very much, Mr. Chairman, Senator Danforth, and members of the committee.

First of all, I would also like to thank you for holding these hearings on the competitiveness challenge facing U.S. industry. As you know, Senator Baucus and I are Co-Chairmen of the Congressional Competitiveness Caucus, and we are very anxious to have as many members of Congress involved as possible. There are now over 160 who have joined this Caucus. It is a bipartisan effort and we are out to seek as much enthusiasm and support for it as we can.

Senator Baucus touched on some of the problems, and you are very familiar with them, I know. Our trade deficit in 1986 hit a

record of $170 billion. We get kind of casual with these figures, but $170 billion is nearly double the U.S. total budget from about 25 years ago.

Now, there are many reasons for this, as you know—the strong dollar, increased foreign investment in the U.S. but to many of us the growing deficit translates into a failure to compete. Clearly, we can no longer rest on our laurels as the premiere industrial nation of the world.

So we have got to change productivity, approaches to productivity, to quality, to management style, to development and training of employees, and approaches to inventory, research, investment, and marketing.

The government can help in all of this, we believe. This Caucus which Senator Baucus and I are involved has the support of a privately funded nonprofit organization, called the Congressional Economic Leadership Institute. We also have the support of the private sector Council on Competitiveness which, as you know, is headed by John Young of Hewlett-Packard and Mr. Metler of TRW.

Now, what do we hope to accomplish? The purpose is not more studies. We have got plenty of those.

Now, there are a whole series of things that we might do. There is not one single panacea, except possibly balancing the Federal budget. That would be the single biggest step we could take, and hopefully we can make steps towards achieving that goal.

We are going to concentrate on five areas: technology, human resources, capital resources, trade policy, and commercial sectors of the economy.

In the Finance Committee, we have already started a series of hearings on trade. They are continuing today. This morning we have some labor leaders that are going to appear before the Finance Committee, and clearly there is going to be an omnibus trade bill. But revising our trade laws is not going to be enough to do the trick.

A key element in the trade bill will be ending unfair trading practices of our trading partners. Everybody says if we can just do that, we will be home free. Well, that is a big step, but it is not enough. It has been estimated that unfair trade practices account for only $10 to $20 billion of the $170 billion trade deficit. So there are other factors.

What we are trying to do, amongst other approaches, is to seek methods of speedy and orderly adaptation of American workers and managers to natural growth and change in the economy, rather than merely aiding declining industries.

Protection, either through quotas or tariffs or restrictive import surcharges or domestic content, we believe—at least I believe—that in the long run it will be detrimental to the interests of the workers employed in those industries, and the country as a whole.

A recent Congressional Budget Office Report confirmed what many of us have long believed: Trade protection has not helped to revitalize domestic industries in steel, footwear, automobiles, apparel or textiles.

Reforming our trade laws can help, but this is not enough either. In education we have got to do more to improve the training and

retraining of our work force and do something about the dropout rate. The national dropout rate is 25 percent; that is, from the youngsters who start at first grade and do not finish high school, the percentage is 25 percent. In the capital city of my State, Providence, Rhode Island, the dropout rate is 40 percent, if you can believe it. And we are going to try to do something about that.

In the Banking Committee, we have got to be looking at areas where we can be helpful, such as reforms in the Foreign Corrupt Practices Act, and certainly we have to reevaluate our export control policies. How can we ever be a reliable exporter if our export control policy is formulated solely on the basis of national security, totally separate from an overall trade policy?

There was a recent report on that which I am sure you saw, the National Academy of Sciences report, which says attempts to keep high technology from the Soviets has not worked, but it has cost our nation approximately 188,000 jobs and $9 billion in trade in 1985 alone.

In the Judiciary Committee, I would hope that they would look at our antitrust laws. Perhaps we should permit our firms injured by exports to merge as an alternative to import restrictions.

These are some of the initiatives we are going to be working on. Again, I want to stress it is a whole series of little steps. Except for eliminating the Federal deficit, I do not think there is one single item we can say that will really make a significant difference by itself. It is a series of small items that are going to improve our competitiveness.

Thank you very much,

The CHAIRMAN. Senator Chafee, I agree it is comprehensive when you touch on education. We used to have a saying back in my State, that we were not going to raise the economic level of any until we raised the education level of all. I found, coming to government some 37 years ago, that we had the lowest per capita income, no educational program, and certainly no skills. That makes me comment that back at the State level, of course, we in South Carolina have gotten awfully competitive. A poor State like mine can institute technical training, put on a sales tax for education, attract the great names of American industry, whether it is General Electric, duPont, Timkin Roller Bearing, Champion Spark Plug, Cincinnati Millicron, Digital. Today many of the country's computer boards are made in Greenville, South Carolina.

I watched that trend move and change the competitiveness of all our states. I used to be able to go up and carpetbag Michigan with no trouble at all. They cared less. Now, Jimmy Blanchard, the Governor up there, has a $350 million fund, and he wants industry. He is going after high tech, and I commend him for it.

I have watched other States. I am now reading the stories about Governor Dukakis. That is 25 years after what we in North and South Carolina did 25 years ago, but we welcome it. It is highly competitive. I find now that the competition is changed; that all the governors in all the States are going to put in benefits in order to attract industry.

Rather than North and South Carolina competing to try to get that industry, I find that North and South Carolina competing together against Mexico, against Singapore, Taiwan. And therein, I

think you as a Caucus could be very valuable if you could concentrate our effort specifically on one issue; I hope you two as the Co-Chairs would advise us if we are behind. I think we have been behind. I think the Department of Commerce has been behind, and I think this committee has been behind, and if there is anything within our jurisdiction that we have been lagging on, I wish you would tell us. That is the reason for these hearings, so that we can work with the other committees with the other jurisdictional responsibilities.

But you can concentrate this government and begin to get competitive. I think we are going to have to know the competition. I started to say the enemy. I think we are going to have to know. We are all running around flailing like in a paper bag, saying that we have got to have education, we have got to be able to transfer it, we have got to have more math and science, we have got to have more of this and that. I have been hearing that for 30 years.

We have a good bit of education out there. We always need to improve upon it. We also need better management in this land, I understand. But here at the Federal level, we find that there are comparative advantages of government in this international competition in many, many instances, and that our government is not producing and not competing. So if you can find wherein that occurs, it would be a big help to us. We have Senator Danforth over on the Finance Committee, and we have Senator Bentsen, Senator Packwood, the present Chairman and former Chairman of the Finance Committee on this committee. We all hope to work together.

I agree it will be along process. Everybody said we would have one omnibus bill this year. Senator Baucus, you were right; there is no one bill to get us competitive trade-wise. If there were, you and I would have put it in last year and would not have waited until now.

But there are going to be some useful approaches, such as the Federal Technology Transfer Act that the distinguished ranking member, Senator Danforth, and I co-sponsored last year. We just signed that into law where we can more readily transfer the technology developed at the Federal labs into the private sector and commercialize it.

I have got more to do right here trying to get competitive with this committee and with the budget, as you indicated, and that is the only reason I have not joined the Caucus. But I welcome it. You folks are doing a good job, and I wish you all the luck in the world. I hope you jump on us when you see that we are not doing our jobs.

Senator Danforth.

OPENING STATEMENT BY SENATOR DANFORTH

Senator DANFORTH. Mr. Chairman, thank you very much. I welcome Senators Baucus and Chafee. I will see them later in the morning in the Finance Committee where a similar subject is being discussed.

I want to simply underscore the point they made, Mr. Chairman. I think as Senator Baucus put it, what is required if we are going

to deal with the competitiveness issue is the fundamental change in attitudes in the Congress. We are going to have to look at virtually everything we do and ask ourselves: what effect is this having on U.S. competitiveness?

I absolutely agree with Senator Chafee with respect to the budget deficit. The best trade bill we can pass is to reduce the budget deficit to stay on track with Gramm-Rudman-Hollings, Mr. Chairman—your creation. Every economist tells me that the trade deficit that we are suffering in this country is directly linked to the deficit of the Federal budget.

I feel that the trade problem is also linked to tax policy. I think that, when we passed the tax bill that promoted consumption at the expense of savings and investment, that increased the cost of capital by about 10-percent, and that clobbered education in a number of different ways. I think that was basically an anticompetitive tax bill.

I am not going to beat a dead horse. That certainly is not going to be open in the next two years, but I thought at the time that we should have looked at that legislation through the glasses of competitiveness. We will have trade legislation in the Finance Committee this year. My hope is that it is legislation that the President will agree to, and that it is not just kind of a statement by Congress which would not be acceptable to the administration.

With respect to the budget, I think we have to review the priorities of what we are spending money for. Last week the Secretary of Education appeared before the Senate Budget Committee and presented the administration's proposal for a $5.5 billion reduction in Federal spending for education. About three-quarters of that $5.5 billion would be in higher education.

The Pell grants would be radically cut. The Guaranteed Student Loan Program would be radically restructured. It seems to me that the competitive position of the United States has to be closely linked to education. We have to build on one of the strong points we have historically had in this country, especially the excellence in higher education which we have in the United States.

A $5.5 billion cut to me is the wrong approach. I also agree with Senators Baucus and Chafee that every committee should be reviewing its agenda from the standpoint of competitiveness.

This committee has jurisdiction in matters relating to science, transportation, and communications. All of these are areas where competitiveness can be examined.

So, Mr. Chairman, I also want to thank you for getting into this issue and express my appreciation to my colleagues on the Finance Committee who have worked on this so hard.

Senator BAUCUS. Mr. Chairman, if I might, I think it is critical that we do not try to solve this whole problem all at once. I think it is essential that each committee takes a solid step in the direction in which we want to go. We need a solid bill, a solid movement of some kind to get the ball rolling. It is a matter of overcoming inertia, so that we start this attitude of asking ourselves, how can we be more competitive so that we can beat the competition?

I think we can learn from our most successful businesses. The most successful businesses in America, as I understand it, are those that have a bias for action on the margin. That is, they do not try

to go whole hog, the whole nine yards at once. They take a step at at time. This works because when there is a bias for action on the margin, we learn, we experiment, we know what works, we know what does not work.

And if each committee can begin that process and develop something substantial, not the whole nine yards but something substantial each year, then I think we are going to go a lot farther towards solving this than we will if we, as you put it, flail around and try to solve this whole problem at once.

The CHAIRMAN. Very good.

Senator Adams.

OPENING STATEMENT BY SENATOR ADAMS

Senator ADAMS. Thank you, Mr. Chairman.

I welcome Senator Chafee and Senator Baucus here today. I come from a State that lives on exports and imports, as do many others in the Congress. Last weekend, I tried to make a little analysis of what I call no longer having to try to say get government off our backs, but get government on our sides.

And there are these seven steps and I want to know whether you agree with them. I am concerned that we are going the way Japan did before World War II and Germany did, and that we are becoming a large developing nation. We talk about the connection between the budget and the trade deficit, but it goes this way: We borrow money to buy arms, pay interest on the debt, which does not build a competitive industrial plant. The other competing nations do not.

Second, we pay wages to our people from this, from making these arms in nonproductive facilities and providing services to one another. We then use these wages to buy products from abroad because our home-produced products are dropping in quality and quantity.

Then those selling us products improve their plants with our money, do not pay for defense, and now are starting to lend us money so we can keep going in the process, which is what we used to do abroad with the developing countries.

Then American companies follow the market forces with what I call the short-term or third-quarter syndrome. In other words, look good in the third quarter so the stockholders will reelect you in the fourth. So they fire people and move plants abroad, hire people so they can send in goods to also follow the goods flow here.

At some point we can borrow no more, as we have lost good-paying jobs, so we are left with debt, arms, poor people, and less production.

If we do that, we follow the course the Japanese and Germans did before World War II with a great many arms, certainly the greatest in the world, no productive capacity, and they lost World War II.

I would ask you, are we in the process of losing economic World War III because these two nations have now achieved what they wanted with a different set of policies, and I think their government—I know their government from experience in the last seven

years is on their side with not only Miti in Japan, but the whole European Common Market.

Now, this committee has regulatory power of a tremendous amount, including such things as whether or not other countries must buy our electronics. If we open AT&T, do they have to open all Nippon?

I am very grateful to the Chairman for starting this. I do not believe it is a matter of finance alone. In other words, the problem is not with money tariffs. The problem is with American productivity and with reciprocity of trade. And I am very pleased that you are here this morning and may or may not want to comment on my comments which come simply from sometime experience with the Budget Committee and sometime experience in the private sector, and with an enormous concern at this point about the manner in which we use regulations and the fact that we have to make our plants, people, companies, aware of the fact that they have to find their niche in world trade or else we will become a second rate world power, no matter how much we buy in arms.

The CHAIRMAN. Very good.

Senator Pressler.

OPENING STATEMENT BY SENATOR PRESSLER

Senator PRESSLER. Thank you, Mr. Chairman. I thank my colleagues and the Chairman.

Let me say I think this whole issue of competitiveness is one that everybody can talk about a lot in a positive way. I think it is one of the most important issues.

However, there are some real tough issues that we have to wrestle with that make us competitive. I would mention, in this Senator's view, that product liability legislation, joint and several liability legislation, to make us more competitive because we have a different standard of activity and the cost of lawsuits and so forth than our major competitors, and that makes U.S. products more expensive. And that is a very tough issue to deal with, but it is one that in my judgment is directly related to the cost of U.S. products.

I would also mention some of the environmental things we might do on a unilateral basis. We want to do what is right, but if our major competitors are not doing it, we should seek treaties to see if we can't have other countries doing the same thing.

I have found that we have placed unilateral restrictions on agricultural exports in certain areas that other countries, our competitors, did not meet.

We have already mentioned the military thing, the leaking of the technology to a friendly country and they, in turn, sell computers or whatever else. So there are a lot of issues, very knotty issues here, that have to be grappled with in my view.

I am particularly interested in furthering basic research programs in science and engineering, both in our universities and in the private sector. This seems to me a fundamental element of any successful long-reach effort to bolster the U.S. position in world trade.

In my view, U.S. Federal support for basic university-based research is the key to our future economic competitiveness and na-

tional security. We all recall the launching of Sputnik in the late 1950s and the activities that occurred, the National Defense Education Act of 1958. And let me say, I introduced last year the so-called Strategic Defense Education Act in light of some things that are happening in our universities in terms of graduate studies, particularly in engineering, math and science.

I think today we face similar problems in education as we faced in the late 1950s. University research facilities desperately need new equipment. The number of graduate students in computer science, math, engineering and other technical fields is sharply decreased. In fact, over one-half of our graduate engineering degrees are being awarded to foreign students.

While this is not necessarily bad on the surface, most of those students return home to assist in the technological developments of their own nations. We need to keep that talent at home.

In my view, the key to solving our competitive problems should start with a greater increase in our support of university-based research. I mentioned earlier some of the legislation I have introduced. I also would call for an expansion of the National Science Foundation's Engineering Research Center Program. This legislation would create a graduate fellowship program for highly talented students to study in these critical areas of national need. It would establish a guaranteed loan program for the renovation of university research facilities and would provide tax incentives to encourage greater private sector support of research.

I am pleased that some of these measures were passed as part of the Higher Education Amendments of 1986. However, we have a long ways to go. But these advances cannot be made without some real commitment in terms of funding dollars, and that again is a very knotty problem.

In light of the budget austerity, the real problem facing us is to formulate a plan of action which most effectively balances our need to balance the long-range competitive programs with our very serious budget constraints. That is not an easy task, but if we do not do it I think our standard of living will be substantially lowered in this country in the next ten years.

We are paying lower wages than we have in the past overall. There has just been an editorial this weekend to that point. It asked if we are paying lower wages, why hasn't the standard of living gone down? Well, the editorial answered that because competitiveness has not yet affected the standard of living because family sizes are smaller, there are more transfer payments from Social Security and so forth, from unearned income, so it has not shown up yet. But it certainly will show up in the next 10 years, the lowering of the standard of living.

Everything I have talked about here is difficult. Coming up with more funding is very difficult. Dealing with what I consider a major issue, the product liability issue, is a very hard issue to come to grips with. Dealing with putting restrictions on our own exports that other countries do not, be they environmental or otherwise, is a very difficult issue to grapple with.

So, as Senator Baucus said, each committee is involved: the Education Committee, the Finance Committee, the Environment and

Public Works Committee, this committee, and so forth, the Foreign Relations Committee.

None of the issues are easy. Every one has got a bad downside in terms of our domestic constituencies. So I am glad we are starting these hearings. The competitiveness issue is related directly to a decline in the standard of living of citizens in the United States which I think will dramatically occur in the next ten years unless we take a comprehensive approach on some very hard problems.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator McCain.

OPENING STATEMENT BY SENATOR McCAIN

Senator MCCAIN. Thank you very much, Mr. Chairman. I would like to thank Senator Chafee and Senator Baucus for being here this morning and also for all that they have contributed.

Mr. Chairman, I appreciate very much your holding these hearings on possibly what is the most crucial issue facing the economy of this country. I do not come new to this issue. I come from a State which is very much dependent upon high technology. I have served as a member of the High Tech Caucus in the House and I just would have a couple of comments, Mr. Chairman, and I would appreciate the response of Senator Baucus and Senator Chafee if they so choose, realizing that time is very limited here.

First of all, Mr. Chairman, I was intrigued and very much taken with the report on the President's Commission on Industrial Competitiveness which I know that you are familiar with. As we grope for answers to these problems, I think that many of the recommendations represented by this Commission which was made up of some very distinguished Americans, I think, can provide a very valuable blueprint for some of the actions we need to take.

I think that this Commission also points out, as Senator Baucus has, that there are a number of steps that need to be taken and they need to be taken to some degree separately.

Also, Mr. Chairman, I think it is a disservice to simplify our international competitiveness into a problem solved by cutting the defense budget. I think that we are going to, and have in the past, scrutinized our defense budget but we have to look at increases in productivity, increases in research and development money, education, assist those whose jobs are disappearing with job training facilities which are not presently there, and of course reduce the deficit budget.

I am sorry my colleague from Missouri mentioned that we needed to reduce the deficit and then decried the cuts, the proposed cuts in education which I also decry. But somewhere, some someone is going to have to get these under control and I think it is well worth pointing out that the Japanese spend far less per pupil than the United States does as far as education is concerned, and perhaps we ought to look at some of the other areas of education including why has the cost of a college education increased so dramatically, why is it that we are unable to attract qualified men and women into the teaching profession as well as many of the scientific areas which are so vital to the future economy?

I just also, Mr. Chairman, would like to point out that in this business of the defense budget, I think we ought to look—and I know that the Senate Armed Services Committee is looking very carefully, not so much at the size of the defense budget, but the burden-sharing aspect of the defense both of Western Europe and our Japanese allies.

I would just point out that less than 3 percent of United States oil now comes from the Middle East. About 98 percent of Japanese oil supplies come from the Persian Gulf, and yet it is the United States of America that continues to shoulder the burden for all of the defense of the Japanese Government, and the fact that they just broke the 1 percent barrier of their gross national product being dedicated to defense impresses me not at all, when we are devoting over 6 percent of the U.S. gross national product to defense, approximately 28 percent of our budget.

I think one of the debates and issues that needs to be well ventilated in this Congress is whether the burden for mutual defense is going to be shared both by our NATO allies and our Japaneses allies.

Another fact I think is important is that we spend approximately the same amount of our resources on research and development and the Japanese and West Germans spend about that same amount, and yet about 80 percent of our research and development funds go to military R&D, where theirs are devoted to areas which are driving us out of markets throughout the world.

I appreciate again, Mr. Chairman, your having these hearings and I appreciate the report and testimony of Senator Baucus and Senator Chafee.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Kerry.

OPENING STATEMENT BY SENATOR KERRY

Senator KERRY. Thank you, Mr. Chairman. I appreciate also the chance to take part in these hearings. This is my first hearing as a member of the Commerce Committee. I am delighted to be here with you and my colleagues.

The work of this committee in this particular hearing is of critical importance to the State that I represent—Massachusetts—because we like to think that we have been on the cutting edge of much of the technological development of the country.

We also depend, as my colleague Senator Adams, on exports and we are beginning to feel the pinch even there, despite the fact that we have the lowest unemployment in the nation and the fastest rising rate of personal income.

But in listening to my colleagues, it is clear to me that there is really a consensus on the nature of this problem and probably on the better number of solutions that are in front of us. I know I have worked closely with Senator Baucus as a member of the Competitiveness Task Force over the last two years. I don't think we are lacking for solutions, Mr. Chairman.

We have heard for a number of years about the problem of education and its linkage to skilled workers. We have heard about the

problems of capital formation. We know they exist. We know we are not dealing in a free trade market system anymore. We understand there are countless non-tariff trade barriers in various forms from various countries restricting our access to trade. We understand we cannot compete on price alone; that we are going to have to have continuation of our technological superiority. We understand all these things.

My worry as we enter these hearings in the 1987-88 political season is whether or not competitiveness stands the risk of becoming the buzz word of that season or whether we are jointly going to be able to summon the political will and the sagacity to be able to make a few decisions to establish some priorities from the deficit that I know Senators Chafee and Danforth and others feel strongly about is the first priority, to a number of other things, not the least of which are changes in our management techniques in this country.

I would ask my colleagues, rather than testifying myself, I would ask my colleagues who have come here whether they would venture to establish a priority or two that they think are the beginning points for the Congress of the United States to begin to genuinely attack this problem.

Is there a first-most important step? Are there three, in any order? And would you venture to try to suggest to us what they might be?

Senator CHAFEE. We had testimony from Bob Strauss who, as you know, has been deeply involved in the trade area and is experienced and knowledgeable. He said the issue that is far beyond all the others as far as doing something about our trade deficit is the Federal budget deficit. I mean that was one, two, three, four, and five in priority.

That came from a man who is obviously not of this administration nor of the party that is in control of the national administration. Then he did not go on and list any other priorities.

And I would say that also. Once you get beyond that, I do not think there is a single big item. It seems to me we must attack this in a whole series of individual measures, each of which has a constituency against it, as Senator Pressler said, or else we would have passed it before.

Let me just list three of them, for example. One of them is before this committee, the product liability problem. That is an extremely contentious issue and I believe has not come out of this committee. And we had very emotional hearings on it last year. We have had hearings on it for many years.

The Foreign Corrupt Practices Act. We have passed that in the Senate in the past. Whether we will be able to do it this year or not, I do not know. It dies in the House. Why? Because there are a lot of people who strongly believe we should not change that Act at all. Yet clearly, changes in that Act would be helpful. Changes in our antitrust laws might also be helpful. So that we just don't look at whether there is an American competitor. We would also look at whether there is a foreign competitor.

What would be the problem if Caterpillar was the only heavy equipment producer in the United States? Would that be bad? And

the answer is no. There is competition from Komatsu, so there is competition but not necessarily domestic competition.

Those are the kinds of questions that will come up and every single one of those will be fought, tooth and nail, by people who feel very strongly on the other side about them.

So that I agree with you that we are in danger of competitiveness becoming a nice buzz word. Everybody is for it. Nobody is against it. I haven't found anybody who stands for anticompetitiveness yet.

But when it comes to trying to do something about it, each of these issues is difficult. And except for the big one that I mentioned first, the Federal budget deficit, there is not a single one that we can take and will solve our problems in an extremely significant manner.

Senator PRESSLER. May I just say I really appreciate what you just said, because I think you summarized a whole debate. We did pass a product liability bill out of here, but it failed on the Senate floor. But they are really knotty issues. You take them one at a time.

I mean everyone is for more funding for the universities, for competitiveness and so forth, but then as you say the Foreign Corrupt Practices Act, the product liability, some of the environmental restrictions that are placed on U.S. products, some of the restrictions on agricultural exports that other countries don't meet—and we could go on and on. But those are the real tough issues in this competitiveness thing and unless we address them, however hard they are, and unless people realize the interest we have in trade, we are going to lose our standard of living.

Senator BAUCUS. Mr. Chairman, if I might, I agree, in response to the question of Senator Kerry as to where our priorities are, with Senator Chafee in that the budget deficit is first. And I say so because I think that if we begin to reduce the budget deficit significantly, it will show the world that we Americans are finally getting our act together. We are finally taking some control of our destiny.

I think that will send a very positive psychological signal to Americans and a very positive psychological signal to the rest of the world, to say nothing about the rest of the benefits of reducing the national debt and therefore reducing our interest payments on the debt. I think that is critical.

Part of that, too, goes to the excellent point that Senator McCain made, that tied into the earlier point of Senator Adams: namely, burden-sharing and reexamining our defense expenditures. As Senator McCain said, upwards of 6 percent of our GNP is spent on defense. Japan spends 1 percent, and Canada and Western Europe are spending 2 to 3 percent of their GNP on defense.

If you look at the sweep of history, countries are not defeated by military invasions from without. They are defeated by economic or social decay within. I think national security is not only military security—Lord knows, we want strong military security—but national security is also economic security. And I think this country, when the Budget Committee reports out a budget, should start to reexamine those budget priorities to emphasize economic security.

As Senator McCain said, most countries spend about the same percentage of GNP on a per capita basis on research and develop-

ment. It is about 2.6 percent. This is very interesting. The United States, Germany, and Japan all spend about 2.6 percent of their GNP, on a per capita basis, on research and development. That includes government and private spending. But the fact is that those other countries spend all their R&D on civilian R&D and virtually none on defense.

I know about all the defense spinoffs. They are tremendous, they are great; but the point is we cannot continue forever to give these countries a national security free ride. We can't do it, in my personal judgment. There has to be more burden-sharing and more cooperation among allies if we are going to have the resources to devote to infrastructure, to education, to all that we have to do to make ourselves more competitive.

In addition to that a top priority, of course, is trade legislation. We have to give our President more arrows, a trade quiver, so that he can be more aggressive in pursuing trade policy.

Unfortunately, this President has not been nearly as aggressive as he could be in using the tools that he now has, but if we give him a few more tools, perhaps he will get the message and be a little more aggressive to encourage other countries to knock down some of their unfair trade practices.

We are not Simon-pure, but I think most other countries are even less pure. For example, Korea will not let in a single auto in its country, not a single automobile. We buy leading edge computers. They will not allow a single computer to be imported into Korea.

There are lots of examples. It just seems to me that that, too, is a very top priority.

Third, I would just repeat what I said earlier; namely, a top priority is for each committee to pass something solid this year because this is a process, an attitude, it is a continuum. And we all have to, as members of Congress and members of committees, begin to do something positive, and that will get the ball rolling. It will start the cycle going in the right direction.

The CHAIRMAN. In thanking you both, I am constrained by time. I think what we are going to have in this committee is a hearing of the Senators, and I don't say that facetiously. It would be good if we all got together. Maybe what we can do in that caucus of yours is to get all the Senators and Congressmen together, because I want to get right into this discussion.

Our number one problem, Senator Chafee, rather than the deficit, on which, of course, I am persuaded already with Gramm-Rudman-Hollings, I would say is enforcement of trade rules. We need enforcement rather than an additional quiver of powers for presidents, whether they are Republican or Democrat. They have not enforced our trade laws whether they be, 301, trigger price, antidumping, or escape clause.

If I could get one single bill through the Finance Committee, it would be a import licensing system which we could computerize through Treasury. With it, we would know where our bilateral agreements were being exceeded and violated, and we would have a correlation of just the laws we had on the books over the past four or five years. It would develop into an orderly trade policy.

Congress has been spewing out these laws over the years. They are all on the books but they are not in force, so I don't believe they need more powers. I say yes, the deficit is important and we are going to keep their feet to the fire. But even if you could balance the budget this afternoon, you would not increase trade with the Pacific Rim one bit. One problem with the deficit has been to get the dollar down from its over-valuation, which, in fact has happened. The dollar has devalued 28 percent against other major currencies, but Japanese trade increased by 28 percent to $80 billion in 1986.

And you will not be able to ship an extra car, an extra yard of cloth into Hong Kong or wherever without enforcement of our trade laws. We can go right on down the list of things. On defense there is no question, Admiral McCain. You and I have got to get together and get the Japanese to take a greater defense position all the way from Japan on down to Australia, in the Pacific and South Pacific.

The Seventh Fleet is stretched. It cannot adequately handle all the territory Alaska down through New Zealand to the Antarctic. You would never give the Japanese a nuclear fleet, but you could give them a navy and let them take over that expense, which is considerable. We could get into all of these things.

I can't thank you two gentleman enough for coming and presenting the Caucus's views here this morning. We want to get on with these other witnesses.

Any other questions? We thank you very much.

We want to emphasize that in calling this panel as they come up—Dr. George Kozmetsky, Mr. Howard D. Samuel, and Dr. Richard Cyert—that the Senate Commerce Committee wanted to begin the 100th Congress with a purpose. We wanted to show to our colleagues in the Senate, the House, and the Government that we are really intent on learning about the problem and trying to solve it.

I do not know of three better minds in America than the three witnesses that we have here. Both experience and their acumen is considerable. Dr. Kozmetsky has been both in the instructional and the development end of industry. He has not only been the Dean of the Business School at the University of California at Berkeley and the University of Texas at Austin, but he organized Teledyne corporation. We always jibe these college professors by saying well, if you are so smart, why aren't you out there doing it yourself?

The doctor has done it along with others, commercializing technology resources for competitive advantage. This particular hearing will give the Commerce Committee a running start. That is, a compendium of the problems and issues; not only from the Young Commission Report, but from many the different studies, bringing us up to date.

We could have a lot of hearings and come out with a similar report. I would hope that with this particular report and with this running start, we can begin to concentrate our efforts.

Dr. Kozmetsky, we really welcome you. Mr. Howard Samuel of AFL-CIO served on the Young Commission, and you are also on the Council on Competitiveness, which is a son of the Young Commission. You are one of the better minds in America today with objectivity from the workers' viewpoint and who knows industry and

knows it intimately. And, of course, Dr. Cyert here from Carnegie-Mellon also served on the Young Commission and also is now a member of the Council on Competitiveness.

I am going to put your introductions in the record and we will not limit your time, but we would ask you to summarize your statements. We have these statements here, and you can summarize and highlight your submissions. They will be included in the record in full as you wish. We do not want to cut you short. We will have to go to the five-minute rule for the Senators themselves, so we will be able to get around the table and then maybe have a second round.

But, Dr. Kozmetsky, we will start with you, sir.

STATEMENTS OF DR. GEORGE KOZMETSKY, EXECUTIVE DIRECTOR, IC-SQUARED INSTITUTE, UNIVERSITY OF TEXAS; HOWARD D. SAMUEL, PRESIDENT, INDUSTRIAL UNION DEPARTMENT, AFL-CIO; AND DR. RICHARD CYERT, PRESIDENT, CARNEGIE-MELLON UNIVERSITY, PITTSBURGH, PA

Dr. KOZMETSKY. Thank you, Mr. Chairman, distinguished Senators Adams, Danforth, Pressler, Kerry, McCain and others of this committee. It is indeed a pleasure and an honor to be here.

You will note that in my testimony I have entitled it, to focus and pull it together, "The New Reality of U.S. Competitiveness," and it is both competition and cooperation in global markets.

I cannot help but agree with what has been said so far this morning about the details of this whole problem and how fractionated it is. But for the last four years, we have been struggling with how to put your arms around these problems so that you do achieve advantage in today's global environment.

Essentially, if you are a businessman, you talk about strategies; and if you are—as you are—distinguished in politics, they are called policies. What we must do is get strategies and policies from the public and private sectors in order to pull together talent, technology, capital, and know-how.

The effectiveness of the policies that you take in your sector and the strategies in the private sector, in my opinion, involves more than increased productivity and maintaining quality. The debate between protectionism and free trade in this context, in my opinion, is misplaced because the United States must achieve and maintain a stable growing economy while competing with flourishing economies of developed and rising industrial countries and, at the same time, helping to increase the wealth of developed nations if you have any intentions of providing world leadership, as we have done in the past.

I think it is important that I set forth from the beginning the outline of my testimony. I would like to just briefly cover in the introduction the hypercompetitive environment we are in. Second, I would like to devote a good bit of time to delineating the nature of the competitive challenges facing the United States, spend some time talking about how to work together, which we call new institutional relationships, to address the U.S. competitive challenge, and then end with a few focused and highly selected Federal poli-

cies for maintaining both U.S. technological and manufacturing leadership.

Most of this work comes from the IC² Institute where we started working on this problem in 1983, and we have developed the framework to do this. I have put into the Appendix so that you are not obscured with the details of it.

Let me just tell the two major things the framework points out. Those nations, including ours, who developed the technology do not benefit from it directly unless they do something more. In the view of Thomas Jefferson, knowledge and technology was a free good, and you have to address the fact. It will move from the cities, the states, the countries as rapidly as possible, and I will get into that.

The second, from a strategic point of view, this country has concentrated on building worldwide class innovation centers.

Let me talk about the crown jewels of the United States. If I wanted to point to where we are just outstanding in innovation, it is certainly Silicon Valley and Route 128. Now, if I wanted a name on those jewels on the crown in manufacturing, I am afraid the world class is in the Pacific Rim and not in this country.

So let me see if I can't, in the next slide, present to you what I think is really behind this competition on a worldwide basis, I think there are only two major points on which to focus. First, there is a new technology revolution that encompasses microelectronics, biotechnology, new materials, lasers, artificial intelligence and robots, waste technologies, and communications.

Those are what I will later call emerging industries and they are wide open. No one in the world has the leadership in this area.

Second, there is a worldwide race to educate work forces, and by that I mean all the way from scientists down to managers, including engineers, technicians, and the various functions in between, to implement and utilize these for both domestic and international trade.

Now let's get right into the heart. I don't think we can proceed to focus and struggle with this problem unless we do a few things. Let me sort of build an introduction to this slide.

I believe that competitiveness is, as Congressman Buddy McKay of Florida said, when he announced the establishment of the Congressional Caucus, "It's a new generation crisis. It cuts across traditional boundaries and doesn't fit existing organizational needs." The result is that competitiveness is difficult to bring into focus as a political issue.

In my opinion, it is also difficult to bring the academic theory with corporate firm policy and practices to meet the competitive challenges we are facing. So in my mind the new reality in my mind that is facing our country is one of intense global competition for scientific, technological, and economic preeminence, including domestic hypercompetition. Each state is competing against the other, each university is competing against the other. Large businesses are competing with medium and small-size ones. So we are in the midst of a very hypercompetitive situation.

Now, the nature of this competitiveness challenge can best be illustrated by considering the nature of technological competitiveness from, first, an internal business perspective and how it im-

pacts on Federal policies and then from an assessment of the external environment of which technology base companies compete.

You cannot talk about competitiveness of American industry as a whole. You must divide it, because the nature of the competitive missions are different.

So I have used three. Manufacturing-intensive industries are those where we have lost our leadership. They consist of shipbuilding, textiles, steel, apparel, oil and gas, autos, and consumer electronics.

The second, which I call hightechnology industries and those in which we are well positioned to compete globally. Another way of looking at it: in 1985 those industries spent 2½ times more on R&D than the basic industry corporations in our country, and they consist of aerospace conglomerates, drugs, electrics, information processing, semiconductors, and telecommunication.

The third that we have to look at are emerging industries and those that will be developed by using the revolutionary technology that has moved from invention to innovation and those which I mentioned earlier, and it is up for grabs.

So I would now like to proceed and talk about the manufacturing-intensive industries. Now, you have to understand the business strategy of many of these industries to see why they lost leadership. If you don't mind, I am going to put it in simple terms and perhaps a little bit as a combination academic and businessman.

These industries have been following the generally accepted internal corporate strategy as well as that which we teach. That involves investing in strong unit growth. And we call those stars. Maintaining stable cash-generation units. If we can do that, we call it a cash cow. Hang onto it and increase your investments in it. Or simply, if you cannot see beyond that, we say divest your stagnant weak units or dogs.

So the accepted management strategy is that the goal should be to maintain their position in cash cows and to mimimize reinvestment. Dogs should be managed to generate cash and then be eventually disposed of or closed down, and the funds so garnered be invested in stars.

Now, let's see the results of all of those. The first of these is, you abandon the industry. You do that firm by firm. Now, that creates a lot of problems that we have already heard. How do you retrain, how do you handle all of those problems of a decreasing work force that we have? In the steel and automobile industries, for example, what do you do with those?

The second part of it is, do you go it alone? Do you take on and fight those firms that have come in with cheaper products and higher quality and all the rest? And do you try to catch up with them, or do you try to leap frog? If you simply want to get the American automobile industry to utilize the most advanced knowledge as we have in automation and quality, that's a $75 billion investment.

And if we go through all these industries, it comes to a pretty high number that may start matching the Federal deficit.

The other thing they have done is hollow out the domestic manufacturing capabilities. Stop fighting, move on out. Hang onto the domestic market as long as you can. That creates probably more

cash flow then for manufacturing. Hollowing out gives you all the problems you had before. What do you do? Where do they go? Which parts of the country?

Another one is to enter into alliances with foreign firms. We have seen the answer to this; it is right there. There are so many alliances going on that it is difficult to put them altogether to understand it, but in simplified form, we seem to be outsmarted and out-thunk and out-worked. It is still too early to give you a scorecard on this.

Finally, you accept foreign firms establishing manufacturing in the United States and you, our Federal policymakers, and others have to start thinking about antitrust laws. It is more than just what kind of an industry do we want, but what kinds of concentrations do you want in this country?

It is now being predicted by some, before 1994 we will have 300 Japanese service companies here. If you are to look at systems integration that builds the automation equipment for the automobile industry in this country, we have just slightly over 300. None of them seem to be outstandingly profitable in the last four or five years.

That opens up the whole anitrust issue in an entirely different manner.

Now, let us see if we cannot move on to the higher-technology industries. Now, the competitiveness challenge for the high-technology industry requires contrasting United States and Japanese internal corporate strategies. Both recognize that these industries are starts. They are the ones they are putting the money on. The difference concerns their approaches to using comparative advantage.

In the United States, we focus on the following. By advancing the state-of-the-art product leadership, these companies have targeted high-value, high-customer-interface markets.

Now, this requires continuous innovation and constant interaction with knowledgeable customers and a great tie to the universities where the research dollars are coming from, where the advance in science in new materials, new processes, new techniques, connecting into where the DoD dollars are going and connecting into where NIH dollars are going. It gets expensive.

Now, the Japanese comparative advantage is entirely different. What they focused on was sophisticated process technology. They put the research early into manufacturing to oversimplify, and they did it at the beginning for state-of-the-art products requiring leading-edge manufacturing technologies.

Let's break it down a little more. In terms of product life cycle, United States firms have manufactured products during their introductory and growth stages. I don't have time to detail it all, nor have we finished everything, but our early evidence tell us, if we look at semiconductors, during that phase you make 25 percent of the product's life profit and you make 75 percent of the profit in the later stages of that product.

We call it maturity and declining stages. When the American manufacturers get to that in high technology, they supplement their capacity by second sourcing, joint venturing, or licensing with

Japanese and other nations. If you are looking where I am, Senator, it is page 8, first paragraph.

This meant that United States firms shared the profits of product life cycles with their second sources or joint ventures. Now, to overcome barriers, licensing has been used by the United States to get into Japan and other countries' markets. When they keep us from getting in, you license those companies and you license them in the maturity and declining stages.

Some of the firms have succeeded by this process in establishing a permanent presence in both research and manufacturing in Japan and other countries.

Now, the Japanese in terms of product life cycle, have focused not on the introductory or growth stages, but rather on the mature and declining stages by second sourcing, joint venturing, and licensing. In this approach, they emphasize process technology. It has led them to constantly keep their eye on whether they are going to have advanced process technology, the next generation technology for the devices or products, increased manufacturing efficiency, and to provide basic assembly with semiautomated processes. And it has permitted them in terms of product strategy to duplicate, improve, and develop products and begin to undertake their own research and design, as well as enter into joint R&D ventures.

They are ready now to challenge us on the scientific competitive front. Now that they have moved from manufacturing to technology, they are getting ready to challenge us scientifically.

And so, as the next slide shows, we have three primary challenges in terms of competitiveness in high technology. How do we retain more of the profits as we move through all phases of the product's life cycle?

We know that the Department of Defense and other agencies license advanced technology. It was obvious that the new software for automation was licensed at least three years to Japan and to Western Germany before any U.S. firms got it other than those that were developing it. And when we licensed it, we just took money.

The Japanese would say we would want one-half of the manufacturing from such licenses to be done in this country. So you have got, amongst your other details, to look at our own government's licensing practices.

Next, are we going to play catchup and leap frog through advances in process technology? Where can I go in the United States and find manufacturing processes and advance work being done? There are a number of outstanding universities. But I can't find them out in the real world.

Also, we have got to look at and reevaluate—that means I don't have the answer, Mr. Chairman—the alliances in terms of what do we want temporarily and what do we want long term? How do we go about deploying globally? Do we just want it to be done in an atmosphere where each person and firm decides what to do, each university, each research center, each Federal laboratory?

And finally, is it possible for us to put together some newer developments so that when we do get to the maturity and declining

stages, we can be doing it with collaborative domestic firm efforts. And these are the types of challenges that face us.

Now, let's go to the emerging industries. I have used four of the characteristics of one of our scholars at IC^2 that most of you are familiar with, W. W. Rostow, has named, and he has said this is the nature of the competitiveness in the emerging technologies.

First, they are so encompassing today that no one country can dominate them completely. Where you and the state governments and the industry put their R&D dollars is going to set the priorities for this country. It will determine where we are going to be dominant or preeminent. And you have to think about these.

Second, they are linked to areas of basic sciences that are also undergoing revolutionary changes and we have to decide how do we pull that together and compete and domestically cooperate because you cannot put 200 basic new science laboratories in all these areas in the 200 research universities we have in this country. The cost is beyond any nation's ability. That means maybe we want to cooperate with other nations in this area.

The third is you can immediately transfer this technology to a developing nation. And when you say we are educating more foreign Ph.D's, that is what you are talking about. And if we play it right, these technologies are the key to leap frog.

Let me illustrate that. When the South Koreans started shipping Japan steel at lower prices than Japan could produce it and the Japanese had given them the advanced steel mills, they decided to, first, go into advanced materials, go into building the machinery and the manufacturing of biotechnology. And, third, to come to the United States and get involved in buying up our steel companies in this merger and acquisition that we have going on. They diversified that way. I call it leap frogging.

It is hard for me to find our companies in these types of industries getting back to these emerging technologies. So the challenge is in all dimensions here: the scientific development, to invention, to innovation, to commercialization. But one thing is clear from this committee's point of view; they must rely on government and academia to help meet the scientific challenges involved in these emerging technologies.

Now, these were all internal things. Let's look at all these industries from an external point of view.

Put the next slide up, would you please?

I am not going to spend much time. The marvelous report which came out of the Competitiveness Commission has got the first five, but it is so detailed that I just want to put it up. We failed in key tests of competitiveness from the outside when we look at our industry.

You do not have enough productivity growth. You don't get adequate returns on manufacturing. That means you would rather buy government bonds than stay in manufacturing. We have got the poor trade performances that we talked about and we are getting an ever-eroding share.

Now, the key thing that I have found in the work we have been doing in the last four years is that it is very difficult to find the key business leaders in the United States who want to fight back. It is easier to join them. As one executive from Japan told me, he

said, when the American managers decide to compete with us, they are going to discover it is going to take 24 years to catch up or at least two generations of management. And he continued to say, I do not understand you Americans allowing us in to look at all your technology and advanced things, taking photographs and doing something with them.

I would like to just share with you on a personal basis my perspective because we do a great deal of work with the Pacific Rim nations and I would like to give you what I found in my trip last summer to both Japan and South Korea, which was extended to a worldwide scientific meeting where the Japanese came in to reveal the Nakasone plan and where I also got involved with the Japanese in talking about building commercial launching sites for space manufacturing in the Pacific Islands.

Here is what I came up with. First, Japan is already moving quickly to hollow its manufacturing-intensive and high-technology industries to stay globally competitive and in anticipation of pressures for protectionism measures in other nations.

Second, Japanese firms are accelerating their cutting-edge technologies to provide new indigenous employment and to take advantage of early market opportunities. They want to beat us to the market.

Third, the Japanese have decided to gradually reduce their investments in United States Treasury bills, land, and other financial investments. A former Minister of Finance from Japan says we have carefully analyzed to see what you Americans do. And you buy vacation homes, you buy lots of other luxury things, and we think it is important that these funds gradually be diverted to build wealth worldwide.

And they are preparing to invest in large-scale programs in developing nations, primarily those that encompass two or three developing nations. And their objective is to provide newer investment in these nations' infrastructure that can increase their economic wealth in that nation as well as build an export market for Japanese goods and services.

Fourth, they have passed laws to encourage the building of more than 100 research and international exchange facilities around Japan for the next ten years. And these programs utilize both private management and some special forms of guarantee like we did with student loans for a secondary market when we formed one of the first profitable congressional corporations in this country.

Now, let me tell you the attitude of the Japanese management as I see it. They are proud to be world leaders. They are intensifying their efforts to maintain their world lead, and their efforts today are more with Pacific Rim nations than with United States.

Next, they are downplaying those factors that contribute to better quality of life: housing, better transportation, retirement, and social security. Instead, they are focusing on maintaining their competitive advantage and anticipating the next round of trade and tariff discussions.

Two major new investments are being made by Japan. One is to accelerate their scientific research for scientific and economic preeminence and the other is to build new manufacturing plants in foreign nations, including the United States.

Now, South Korea, in my opinion, is a very modern manufacturing nation in manufacturing-intensive industries and is moving rapidly into high-technology industries. And it took them 17 years to get to this stage. They have educated their people in that brief period and they are very competitive. But their attitude is, first, maintain a political environment favorable for business. I wish we would look at it from our antitrust laws, that we wouldn't put up with them.

Second, invest in the world's most efficient manufacturing facilities.

Third, expand their defense industry by licensing manufacturing rights to U.S.-developed weapons. I saw aircraft engines and helicopters going in there, and there were more modern plants than I have had the opportunity to see. And they are expanding their educational system so it says we have got to find ways of moving ahead.

One of the things now is can we put together cooperative efforts? How do we focus and get the thing going? It is not just a Federal problem. Since 1980, under the new Reagan Federalism, there has been a great deal of action taking place at the State level primarily. We at IC^2 have been looking at the mechanism being used.

I would like to put the next slide up. We found that there are nine different ways that they have done. For the benefit of time, you have got the slides before you and up there. I won't mention them, except the detail. We find that these have been done for three purposes primarily. The first is for U.S. scientific and economic preeminence. Those are those industrial R&D consortia, of which there are about 55 now. You all passed a law a few years back. MCC is the grandfather now.

You have got to understand the amount of dollars annually flowing into these. No one has really put them together, and in my best estimate, that is about $300 million to $400 million a year.

Then we look at academic and business collaborations. There is so much going on, it is hard to put your hands around it, but I guess that it is about $300 million to $500 million a year.

The next is NSF University/Industry Research and Engineering Centers of Excellence, including the supercomputers. And I really had a fit of enthusiasm. I made that a half a million dollars. I imagine I may be too high on that. Probably $200,000 is better. Now, that is all you are spending out of these newer collaborative, cooperative programs and it is all aimed not at competitiveness, except to be scientifically and hopefully economically competitive. I already told you: develop the science, develop the technology, and it flows. It does not guarantee you any economic preeminence.

Now, there has been some new relationships to develop and maintain our emerging industries, again the industrial R&D consortia, and then let us look at that. We have got two problems. We cannot find any corporation of any size. We cannot find any Federal laboratory or much teaching today as to how do you organize and transfer technology so it ends up commercialized.

We still have in this country the "not invented here" disease. We still do not know how to do the marketing of something that is not a substitute. And then we have the university intellectual property commercialization and you have passed laws on that. It is kind of

nice to watch the universities of Stanford and MIT—and sorry, Dick, I do not know yours. As I look back four years ago, they got a million and a half a year ago from the intellectual property. It climbed to four last year, and probably will hit $6 million.

There is not very much money flowing back from these intellectual properties. There is a long way to go there. And there has been a great deal of effort being done to create small and take-off companies, and that is the emphasis we put in this under the state and the Federal things I am talking about here—to be innovative.

We got incubators. My guess is we have got 150 in the United States now. We are probably on our way to at least 500, but I don't think more than $200 million is going in.

The big dollar is what you already passed—small business innovation research. There I can say you are talking about a billion dollars, and that is one of the bright stars. Now, we will get to how much is a billion in a few moments.

We have about 26 states that passed some form of state venture-capital funding, and that is not more than $400 million when you put it together, going in annually.

Risk-capital networks. I like my working title for it. It is "business angels," wealthy individuals. They are putting in $14 billion a year where we can best do it.

Venture capital, that we all go around the world talking about how we great are, at most has only been $4 billion. There is nothing we can find to put cooperative efforts together to make us a world-class center in manufacturing.

So, yes, we have collaborative ways of pulling together. We have ways which I am going to suggest that the Federal and State and local government, academia and business, should cooperate.

So let me just come to the ending and go to the next slide on some fairly selected Federal policies. The first one is policies for science and technology transfer and commercialization. Obviously I am aiming at the emerging industries there. We have got to direct our R&D more effectively. How do we go about doing this?

We have got to support more basic R&D in the nondefense areas.

The second part of that is to reexamine every basic scientific program from an emerging industry global competitiveness, and you can read the last two, but let me get specific. When I put together ten years of basic research funds appropriated by Congress, the total amount is about seven times that which you gave to NSF.

When I put together what you gave to NIH in health research and applied research, it is 1-1/2 times larger than what you gave to NASA. And you did not put a nickel in to get ready for commercialization.

We have four medical schools in The University of Texas System that I work with, and so on that extremely small sample—and we are the second-largest recipient of such funds in the United States—we let Harvard always be number one—and we can tell you this: In order to make that intellectual property commercializable and get some returns back to the research institution so you do not have to continuously fund dollars from the tax bill, we have to spend, on the average, $250,000 to get it ready so that you can commercialize it and start getting revenues. There is no money being allocated anywhere.

We have some experimental programs going on. They are obviously collaborative and I will not bore you with them.

Next, let's go to transferring commercialization. I do not need to tell this august committee how much you are already putting into Federal laboratories. I do not need to tell this august committee the billions you are putting into universities for research. It is probably $25 billion in this coming budget.

But you better relook them and say, have you got any funds to transfer those technologies? You ought to be picking up some of that. We are saying you should be encouraging incubators. We have an experiment of one which is probably terrible to extrapolate from, but we work from Los Alamos with no Federal monies, some of the private sector money there, and an allowance from the University at Berkeley to borrow a $120,000. We sent up an incubator. It took us $700,000 of study to decide how to do it. It filled up immediately. They now are extending that incubator.

Now, that worked at Los Alamos. I do not think it is going to work everywhere. My best example is Rensselaer who took their contracts and their own university funds, established their incubators, and we can tell you in four years they provided 500 jobs in Troy, New York, just spinning out of it. Fifty million in sales.

The last one, number two there, what I have been thinking of, I have always been biased from the work I have done in the defense effort in this nation and other things I have looked at, that if you commercialize—that is, for the nondefense market—at the same time you are doing defense work, you could really give us a leg up. We did that with a tanker and got the Boeing 707, and that is one of the good examples where you had both commercial production and military production going on together.

Now, can we start looking at limited R&D partnerships which will come from the private sector working with both the universities and our labs to see if we should do it? One example I am working on—we have the NMR. It came out of Los Alamos. The next round of product is called biomagnetism. Working gorgeously now. And all we need to do is get a limited R&D partnership with venture capitalists or some other sources, go in there and develop the commercial aspects.

Now, finally, let's go to B, the next slide. I think we need to announce to the world that we are really going after advanced manufacturing. I would like to see a whole series of cooperative programs which involve the Federal leadership, funding from business, state government, universities, and perhaps a modicum of seeding from here, and get moving on it.

Now, the B part is important. We have provided twice the percentage of employment in the United States in the last 15 years than Japan and it is all small and medium-sized businesses. If they are going to expand and compete and become the next Fortune 100, they cannot have access to the advanced research and developments that are going on now to really push their manufacturing capacity. They have got to get into supercomputers, CAD-CAM, advanced software, flexible manufacturing. It has got to be hands-on. These centers have got to provide for these small growth companies and the medium-sized growth companies to narrow this gap.

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I agree with the senators who testified earlier. Yes, this is a ten-year or more problem. If we are going to close that gap, we have got to get some of that done. And let me tell you, the second part says yes, you have got to put the money in education, but direct it. We don't have theory and applications going on together.

President Cyert, an old colleague, one of the few institutions that is doing that and has done it for 30 years. They not only teach and do research for understanding, but they carry on what every university of a research nature must do—it is understanding for use. It is a whole new ballgame of doing work in the universities and we have got to do that.

Because there is so much more to be done that we have not done, but we are perfectly willing to work with this committee. If you do want to work in this area, appoint a national Commission for Advanced Manufacturing, if nothing else to detail the priorities and integrate them for a stable growth across our country.

I know other speakers following me are going to do more with the next set of policies, which I call educating work forces. In my personal opinion, we have got a long way to go in training management as well as scientists and engineers and others. We have got a tremendous problem to overcome, and again we had better start looking at centers and institutes for global competitiveness and cooperation. We do not have to invent everything here. We do not have to have every bit of knowledge to be taught out of here, especially in these emerging areas, and we should make contact, and we should encourage these multidisciplinary educations.

Also, let us relook at training and retraining for manufacturing for our workers, and let us be sure we get them ready for the emerging industries.

Perhaps I ought to end with a startling recommendation. I think it is time we had a private sector vitality program. In Japan, that is called Min Kat Su Ho. It consists of six parts. We have got to have research across at least the 50 states or more, depending on where the regions are, so they begin the brains of a high-technology industry. We have got to have open research lab space where you can lend out space for joint company R&D. You have got to have R&D facilities for those corporations that want to grow and the capital ventures that are helping them grow.

You have got to have research facilities for technical engineering firms at low fees so that they can move out of the incubators and into these areas. We have got to exchange facilities and provide information on latest R&D efforts and technical information.

In 1954 and 1957 we were doing that with our defense program by holding two meetings a year, one classified and one unclassified, so that people could come and find out.

We have got to have international exchange facilities, fairgrounds where people can come and show their latest developments. They are not going to let us in with cameras. You know that.

We have got to have exhibit halls of which we are really short across this country, and we have got to have international conference rooms. We have got to learn to deal with media and the new telecommunications, so we ought to have places and centers where people can come from various places.

The Japanese say you also need a telecommunication plaza. I visited one this summer. They already had every major banking and investment firm in the United States housed in a 30-story building. They had two condominiums next door to it. They have a symphony hall, a three-story waterfall, exhibit areas outside, the most luxurious hotel that I have ever stayed in in my life. We have got to get moving.

We also need to learn to do telecon communication. The money flows that are coming up are not going to be like we have had to date. Right now, all the new mechanisms we are using require a network being set up, working around this, so we have got to get ourselves to be part of it or they are going to take it away from us. There is a lot of work to be done.

Now, in Japan, this is a $9 billion program over a period of 10 years.

I would like to talk about $10 or $15 billion program. How do we do it? It says there has got to be an agreement—and we did surface this in 1983, Mr. Senator, when I first met you—it says we have got to get the state governments involved and look at what they think is the best for them. If not a problem, that we can give certain advantages of state and local taxes. Perhaps we should reexamine if there is any need for anymore Federal tax on it. We can have bank loan guarantees. Maybe we need to be done with it, and we can get this moving without constantly always putting in our own dollars.

Thank you very much for the honor of being here.

[The statement follows:]

THE NEW REALITY OF U.S. COMPETITIVENESS: COMPETITION AND COOPERATION IN GLOBAL MARKETS

by

George Kozmetsky

Introduction

The U.S. is in the midst of an intense international competition for scientific, technological, and economic preeminence. There are two major drivers behind this hypercompetitive environment:

- A new technology revolution that encompasses microelectronics, biotechnology, new materials, lasers, artificial intelligence, robots, waste technologies, and communications; and
- A world-wide race to educate workforces to understand, implement and utilize newer technologies for domestic and international trade.

These drivers are altering the nature and structure of the worldwide economy as well as that of the U.S.

The old economy emphasized cheap and abundant natural resources, lower labor costs, borrowing over savings, growth over efficiency, and quantity over quality. The new economy emphasizes sustained productivity over rapid expansion, adaptability and flexibility over efficiency and effectiveness, and quality and choice over quantity and rigidity. It is an economy in which

growth is based on technology diversification and the changing needs and values of demographically shifting populations. This economy puts an ever-increasing value on continuous innovation and responsive product development to segmented worldwide markets. Economic commercial advantage thus depends on effectively linking talent, technology, capital, and know-how.

Achieving competitive advantages in today's global economy requires new strategies from the public and private sectors in order to effectively pull together talent, technology, capital and know-how. The effectiveness of the strategy selected, in my opinion, involves more than increasing productivity and maintaining quality. The debate between protectionism and free trade in this context is misplaced. The U.S. must achieve and maintain a stable growing economy while competing with the flourishing economies of developed and rising industrialized countries and at the same time helping to increase the wealth of developing nations.

To do this, the U.S. must stay in the forefront of developing, applying, and marketing new technologies, expand the capabilities of our human resources, and build newer institutional relationships that reflect the new realities of a hypercompetitive global economy.

The IC² Institute of The University of Texas at Austin has been working on issues related to U.S. competitiveness in global markets since 1983. Our key thrust has been on accelerating the technology commercialization process. The process of

commercializing technology resources requires the timely transformation of research and development activities into viable products and services to achieve and maintain competitive advantage in domestic and global markets. The effectiveness by which technology is commercialized will have a direct impact on U.S. competitiveness. IC² Institute research on the commercialization process has resulted in the development of a framework for economic growth through technology. The framework presents a way for creative and innovative leaders in both the public and private sectors to understand and implement strategic approaches to economic development and technological diversification. It assesses public-private infrastructure requirements, details institutional developments for private capital formation and for more competitive collaborative efforts, and outlines the role of entrepreneurship in building indigenous companies. The framework emphasizes the need for both innovation centers for research and development and manufacturing centers for job creation. (Appendix A includes a paper that details this framework.)

Research and conference activities for commercializing technology resources have included

- commercializing strategic defense technologies;
- examining collaborative relationships among government, business, and universities to accelerate commercialization;

- encouraging technology transfer and diffusion, especially in the U.S. federal laboratory system;
- encouraging ways to enhance U.S. competitiveness in global markets; and
- presenting new approaches to technology marketing to facilitate commercialization.

The remainder of my testimony will cover

I. The Nature of the Competitiveness Challenge Facing the U.S.

II. Newer Institutional Relationships to Address the U.S. Competitiveness Challenge

III. Selected Federal Policies for Maintaining U.S. Technological and Manufacturing Leadership

I. Nature of the Competitiveness Challenge Facing the U.S.

A. Introduction

Competitiveness is, as Congressman Buddy MacKay of Florida stated in announcing the establishment of a new, non-partisan Congressional Caucus on Competitiveness, "a new generation crisis. It cuts across traditional boundaries and doesn't fit existing organizational charts. The result is that competitiveness is

difficult to bring into focus as a political issue." In my opinion, it is also difficult to bring together the academic theory with industrial policies and practices to meet U.S. competitiveness challenges.

Leaders in business, government, labor, or academia must act in spite of the fact that the multi-focused problems and issues of U.S. competitiveness are unstructured. In my opinion, their actions are more likely to succeed if they are based on the new realities of a changing world economy.

The new reality facing our country is one of intense global competition for scientific, technological, and economic preeminence. The traditional paradigm that science and technology naturally evolve into commercialization that makes and secures a nation's future is inadequate. It does not adequately (1) provide employment opportunities; (2) mitigate layoffs; (3) maintain a strong global competitive position; (4) make for economic security; and (5) present growth opportunities across the board. The nature of this competitiveness challenge can be best illustrated by considering the nature of technological competitiveness from an internal business perspective and from an assessment of the external environment in which technology-based companies compete.

B. Technological Competitiveness -- Internal Business Perspective

From an internal business perspective, the nature of the technological competitiveness challenge can be considered along

three lines: manufacturing-intensive industries, high technology industries, and emerging industries.

Manufacturing-Intensive Industries. The U.S. has lost its business leadership in a series of such industries. Among these are shipbuilding, textiles, steel, apparel, oil and gas, automobile, and consumer electronics. Many of the business firms in these industries have been following the generally accepted internal corporate strategy and decision making that involves investing in strong, high-growth units (stars), maintaining stable cash generating units (cash cows), and decreasing investments, or divesting stagnant weak units (dogs). The accepted management strategy is that the goal should be to maintain their position in the "cash cows" and to minimize reinvestment; "dogs" should be managed to generate cash and then to be eventually disposed of or closed down. The funds so garnered are to be invested in "stars".

As a result of these internal policies, strategies in manufacturing-intensive industries can be briefly viewed as follows:

1. Abandon the industry.

1. Go-it-alone to try to catch up or leap frog.

3. Hollow out domestic manufacturing capability.

4. Enter into alliances with foreign firms.

5. Accept foreign firms establishing manufacturing in the U.S.

The challenge has devolved from leadership to catch up, join them, or give up.

High Technology Industries. These are industries where I believe the U.S. is still well positioned to compete globally. High technology industries include aerospace, conglomerates, drugs, electronics, information processing, semiconductors, and telecommunications. These are the industries that, as a group, invested in company R & D 2-1/2 times more in 1985 than those firms in the basic industries. These are the industries that are developing alliances with foreign firms or locating offshore to share the costs and to share the risks associated with product life cycles which have grown shorter and which will grow still shorter with design automation.

To get at the nature of the competitiveness challenge for the high technology industries requires contrasting U.S. and Japanese internal corporate strategies. Both recognize that these industries are "stars". The difference concerns their approaches to using their comparative advantages in terms of product development, marketing, and manufacturing.

U.S. firms have focused on advancing state-of-the-art product leadership. They have targeted high value, high customer interface

markets. This requires continuous innovation and constant interaction with knowledgeable customers. Japanese companies have focused on sophisticated process technology for state-of-the-art products requiring leading-edge manufacturing technologies.

In terms of product life cycle, U.S. firms have manufactured products during their introductory and growth stages. During maturity and decline stages, they have supplemented their capacity by second sourcing, joint venturing, or licensing with the Japanese and other nations. This has meant that the U.S. firms shared the profits of the product life cycle with their second sources or joint venturers. To overcome barriers, licensing has been used by U.S. firms to get into Japan and other countries' markets. Some of the firms succeeded in establishing a permanent presence in both research and manufacturing in Japan and other countries.

The Japanese, in terms of product life cycle, have focused not on the introductory or growth stages but rather on the mature and declining stages by second sourcing, joint ventures, and licensing. This approach emphasized process technology. It has entailed developing next generation technology, increasing manufacturing efficiency, and providing basic assembly with semi-automated processes. It has permitted them, in terms of product strategy, to duplicate, improve, and develop products, and to begin to undertake their own research and design as well as enter into joint R & D ventures.

Thus, there are three primary challenges to U.S. high technology firms:

1. Retain more of the profits as they move through all four phases of the product life cycle.

2. Catch up and leap frog through advances in process technology for manufacturing as well as productivity and quality.

3. Reevaluate the mechanisms for alliances in terms of

   a. temporary and long term benefits;

   b. global development deployment; and

   c. collaborative domestic firm efforts.

My experience has shown that there are in reality two major gaps. The first gap involves the fact that we are behind the Japanese in process technology for manufacturing. The second gap is the shortage of both talent and know-how to manage manufacturing, marketing, and financing of products through entire life cycles, especially when the product life cycles are getting shorter and shorter. We still have the "not invented here" syndrome. Few organizations, including federal laboratories, have effectively organized for technology transfer or commercialization within a globally competitive market.

Emerging Industries. These are industries which will be developed by using those revolutionary technologies that are only now beginning to move from invention to innovation, such as lasers, new materials, biotechnology, international networks, very large integrated circuits, medical instrumention, and breakthrough managerial methodologies. They have the following four characteristics, as pointed out by W. W. Rostow:

1. They are so encompassing that no one country can dominate them completely.

2. They are linked to areas of basic sciences that are also undergoing revolutionary changes.

3. They are immediately transferable to rapidly industrializing nations.

4. They are key to leap-frogging for basic industries.

These industries are being challenged across all dimensions from scientific development, to invention, to innovation, and to commercialization. These industries must rely on government and academia to help meet the scientific challenges involved in these emerging technologies.

C. Technological Competitiveness -- External Business Perspective

From an external business perspective, we have failed to meet a number of key tests of competitiveness resulting in:

1. Insufficient productivity growth.

2. Inadequate returns on manufacturing assets.

3. Poor trade performance, even during periods of weak dollars.

4. Eroding world market shares, even in high technology sectors.

My perception of the attitude of key business leaders in the U.S. is that many would rather "join up" than "fight back." In fact, most businesses are concerned with keeping control of our domestic markets even if it means manufacturing abroad or distributing foreign-made products.

Last summer, my visit with Japanese and South Korean executives left me with the following impressions:

1. Japan is moving quickly to hollow its manufacturing-intensive and high technology industries to stay globally competitive and in anticipation of pressures for protectionist measures in other nations.
2. Japanese firms are accelerating their cutting-edge technologies to provide new indigenous employment and to take advantage of early market opportunities.
3. The Japanese have decided to gradually reduce their investments in U.S. treasury bills, land, and other financial investments. They are preparing to invest in

large-scale programs in developing nations. Their objective is to provide newer investments in these nations' infrastructures that can increase their economic wealth as well build an export market for Japanese goods and services.

4. They are passing laws to encourage the building of more than 100 research and international exchange facilities around Japan over the next ten years. These programs utilize private sector management and funds.

5. Management attitudes in Japan can be summarized as follows:

   a. Japanese managers are proud to be leaders. They are intensifying their efforts to maintain their lead. Their competitive concerns today are more with Pacific Rim nations than the U.S.

   b. They are down-playing those factors that contribute to better quality of life -- e.g., housing, public transportation, and retirement and social security. Instead, they are focusing on maintaining their competitive advantage and anticipating the next round of trade and tariff discussions. Two major new investments are being made by Japan. One is to accelerate their scientific research for scientific and economic preeminence; and the other is to build new manufacturing plants in foreign nations, including the U.S.

6. South Korea is a very modern manufacturing nation in manufacturing-intensive industries and moving rapidly into high technology industries.
7. Management attitudes in South Korea are:
    a. Maintain a political environment favorable for business.
    b. Invest in the world's most efficient manufacturing facilities.
    c. Expand their defense industry by licensing manufacturing rights to U.S.-developed weapons.
    d. Expand their educational system.

If we are to maintain U.S. preeminence in high technology industries, then we must find newer ways to maintain a global competitive edge in these arenas. Maintaining political and economic/manufacturing advantages requires that we begin to think and act in new ways to commercialize technological resources, wherever they may be.

If the U.S. is to meet the competitiveness challenge facing this country, then we must take more of a globalization view and less of a parochial view. It is necessary to recognize that there is more and more emphasis on locating the best possible places in both economic and political terms around the world to conduct R & D, manufacturing, marketing, and financial activities. There is more and more emphasis on the world as a single marketplace rather

than one subdivided nationally or regionally.

Global competitiveness focuses on developing global relationships for science and implementing cooperative and competitive strategies among trade partners and allies. Competitivess and cooperation seem tc be a paradox. But they are actually the cornerstones for a more effective U.S. stragegy for commercialization.

Competition is the outcome of those national attributes that help individuals and firms to perform more effectively and efficiently. The outcome of competitiveness enhances the relative strength of companies, facilitates international trade, and adds to the world's quality of well being. Cooperation among scientific and technological organizations can become the source of leading edge high technology industries. Improved processes for commercialization, for example, require more effective interaction among federal labs, industrial labs, and universities.

Improving U.S. competitiveness for the future, in my opinion, demands an integrated, holistic approach that blends technological, managerial, scientific, socio-economic, cultural and political ramifications in an atmosphere of extreme time compression. This approach centers on new ways for the government, business, labor, and academia to work together.

II. Newer Institutional Relationships

The past five years have seen a number of new relationships develop around technology to ensure U.S. scientific and economic preeminence, to develop and maintain emerging industries, and to create small and take-off companies. (See Chart A.)

These institutional arrangements involve new linkages among business, government and academia. They seek to ensure scientific and economic preeminence by focusing on the creation of National Science Foundation centers of excellence in research, supercomputers, and engineering, government/business/university collaborative arrangements in technological areas, industrial R & D joint ventures and consortia, and National Science Foundation sponsorship of industry/university cooperative research centers. These are intended to provide basic research programs that are too large for any one company to undertake alone.

Institutional relationships for developing emerging industries involve academic and industrial collaboration and industrial R & D consortia. Because the basic research is carried out in universities and colleges, securing collaborative efforts between academia and industry can accelerate the commercialization of basic research into emerging industries.

Institutional developments for creating small and take-off companies including incubators, SBIR programs, state venture capital funds, and risk capital networks. All provide seed capital

for emerging companies. They are also pushing regional and local economic diversification through entrepreneurial activities.

III. Selected Federal Policies for Maintaining U.S. Technological and Manufacturing Leadership

In my opinion, there are two major areas for federal policy action that can help maintain U.S. technological leadership and industrial success. One is in the area of science and technology transfer and commercialization. The other is in promoting advanced and modern process technology for globally competitive manufacturing.

A. Policies for Science and Technology Transfer and Commercialization.

1. Direct R & D more effectively.
   a. Support more basic R & D in the non-defense areas.
   b. Reexamine basic science programs from an emerging industry global competitive basis.
      (1) Focus on those disciplines including multidisciplinary areas that are essential to maintain U.S. scientific and economic preeminence, such as advanced materials and human frontier sciences.
      (2) Focus on those areas that may require alliances with other nations because of costs or need of our knowledge to catch up and surpass.
2. Transfer and commercialize technology.
   a. Review existing major R & D programs to ascertain if

CHART A

NEW INSTITUTIONAL RELATIONSHIPS

Purpose / Newer Forms	For U.S. Scientific and Economic Preeminance	To Develop and Maintain Emerging Industry	To Create Small and Take-off Companies
1. Industrial R&D Consortia	X	X	
2. Academic & Business Collaborations	X		
3. University/Industry Research & Engineering Centers of Excellence	X		
4. University Intellectual Property Commercialization		X	X
5. Academic/Business/ Government Collaboration		X	
6. Incubators			X
7. Small Business Innovation Research Programs			X
8. State Venture Capital Funds			X
9. Risk Capital Networks			X

they are sufficiently funded for technology transfer. IC² studies indicate that in the area of health care and delivery there is a need for funds to do the initial required developments for pre-commercialization and to assure that the medical schools and others can benefit from the intellectual property.

b. Encourage establishment of incubators in conjunction with R & D facilities and operations at federal labs and universities to speed the start-up phase of new businesses and to accelerate U.S. leadership in the emerging industries.

c. Evaluate the feasiblity of utilizing limited R & D partnerships among federal labs, entrepreneurs and sources of capital, including venture capitalists.

B. Policies for Promoting Globally Competitive Manufacturing

1. Establish centers of manufacturing.

a. Encourage cooperative programs among business, state governments, and universities.

b. Provide hands-on access for small, emerging, and medium-sized businesses to technologies such as supercomputers, CAD/CAM, advanced software, and flexible manufacturing.

2. Support the accelerated development of both theory and applications of integrated computer manufacturing.

3. Establish a national commission for advanced manufacturing.

C. Policies for Educating Workforces

1. Support and encourage the development of centers or institutes for global competitiveness and cooperation that are jointly sponsored by state governments, industry, and universities.

2. Encourage multi-disciplinary education of managers and engineers in the marketing and financing of global competitiveness by supporting modern curriculum development and research including research for both technology transfer and commercialization.

3. Support the education, training, and retraining of workers for manufacturing in the high technology and emerging technology industries.

APPENDIX A

ECONOMIC GROWTH THROUGH TECHNOLOGY: A NEW FRAMEWORK FOR CREATIVE AND INNOVATIVE MANAGERS

by

George Kozmetsky

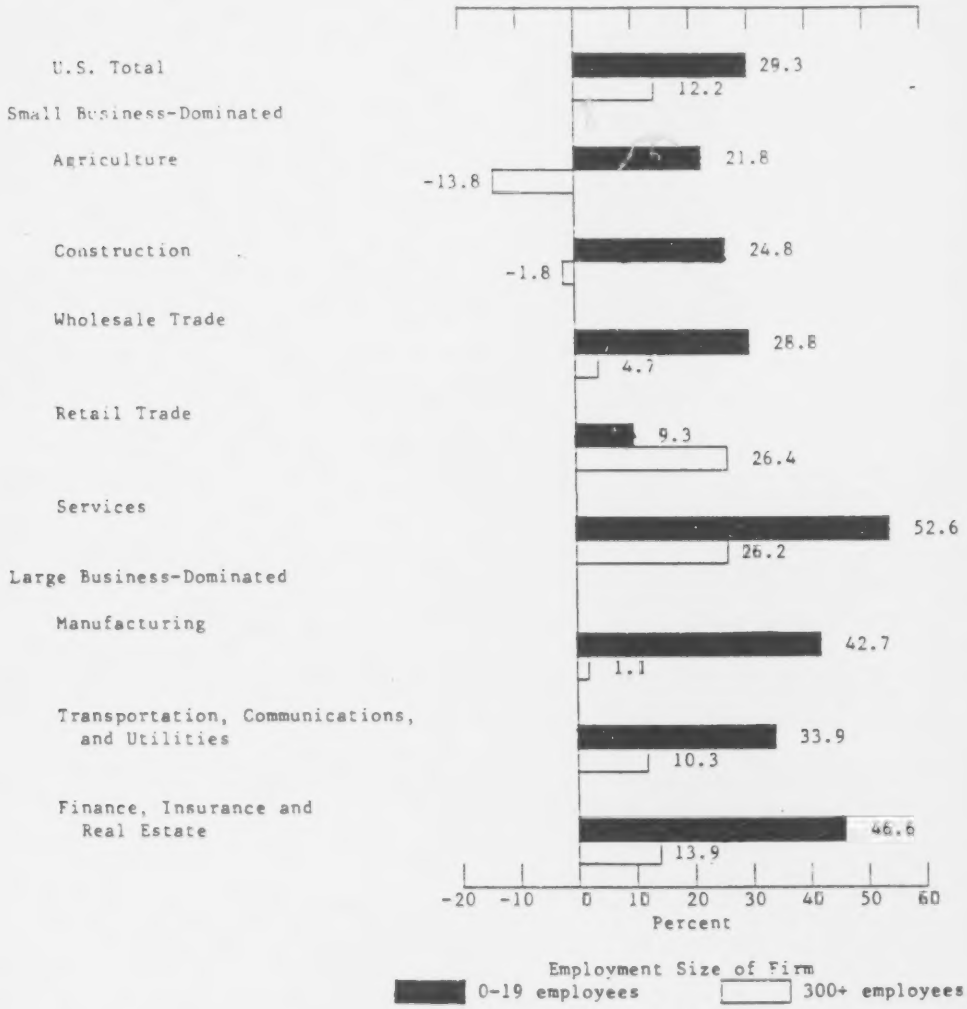
Since the First Industrial Revolution, technology has been a basic motor for economic growth. The management of technology as a resource for economic development and wealth generation is a recent phenomenon. The lessons from the utilization of technology over the past two decades are clear. Those who manage technology creatively and innovatively will reap the benefits of sustained economic growth. They can also play an important leadership role in dealing with new issues regarding competition and cooperation.

The past decade has brought about a transformation of the U.S. economic structure. Since 1974, this structure has become increasingly dependent for economic growth on information technology innovations, coupled with job creation through small business establishments.

Between 1974 and 1984, the U.S. was unique in the world in our ability to create jobs. During this decade, over 24 million jobs were created in the U.S. Since 1976, employment growth in the U.S. was substantially due to the establishment of new, small firms and their subsequent growth through expansion. Small business establishments generated 62.4% of the net employment increases. Chart A shows a com-

CHART A

GROWTH COMPARISON OF SMALLEST AND LARGEST FIRMS ON INDUSTRY DIVISION
1976-1983



NOTE: The U.S. Small Business Administration, Office of Advocacy defines an industry division as small business-dominated when 60 percent or more of the division's sales or employment is found in businesses with fewer than 300 employees. By this criterion, the agriculture, construction, wholesale trade, retail trade, and service divisions are classified as small business-dominated.

Source: U.S. Small Business Administration, Office of Advocacy, Small Business Date Base, unpublished data.

parison by industry of the employment growth between large and small firms. Firms employing 300+ had growth rates that exceed those of small businesses only in retail trade. Those industries that are generally considered to be primarily part of the information economy (that is, services and finance, insurance and real estate), had the largest small firm growth rates. During this period, manufacturing and services employment in Fortune 500 companies actually decreased by more than 5 million jobs.

By 1983, the U.S. economy had been transformed into an information economy, i.e., information industries constituted 51.5% of the GNP, as shown in Table 1. An information economy consists of education, research & development, media & communications, information services (legal, engineering, architectural, accounting and auditing, computer & data processing, medical, financial services, insurance, real estate, wholesale, and governmental services), and information technology manufacturing (robotics, CAD/CAM, numerical controls, printing, computer equipment and software, radio and television, telephone and telegraph, electronic components, instruments for measuring, photographic equipment, medical instruments and supplies, and athletic equipment). More than high technology is involved in an information economy. The largest sectors in rank order are health and medical services, banking and credit, insurance, education, telephone and telegraph, research and development, and advertising. (See Table 2.) Information technology manufacturing's largest industrial sectors in rank order are computers and software, electronic components, radio

TABLE 1

Revenue Estimates of the U.S. Information Economy
Selected Dates and Character of Output 1958, 1970, 1983
(In Billions of Current Dollars)

Character of Output	Machlup[1] Knowledge Production (1958)	Harvard[2] Informational Resources (1970)	IC[2] [3] Information Industries (1983)
Education	$ 60.2	$ 72.1	$ 218.7
Research and Development	11.0	26.6	87.0
Media and Communications	38.4	133.4	244.8
Information Services	18.0	213.0	967.5
Information Machines Information Technology Manufacturing	8.9	not reported	169.3
TOTAL	$ 136.4	$ 445.1	$ 1687.3
GNP	475.6	976.0	3304.8
Percent of GNP	28.7	45.6	51.1

Sources: [1] Machlup, F., "The Production and Distribution of Knowledge in the U.S.," 1962 pp. 354-357.

[2] Harvard University, "A Perspective on Informational Resources: The Scope of the program," 1973-74 p. 2.

[3] IC[2] Institute, The University of Texas at Austin, unpublished survey 1985.

TABLE 2

Revenue Estimates of U.S. Information Economy

By Service Industries
(in billions of dollars)

	Machlup[1] 1958	Harvard[2] 1970	IC[2] [3] 1983
Legal	$ 3.0	$	$
Engineering and Architectural	2.0	8.5	31.5
Accounting and Auditing	1.1		
Medical (including Surgical)	2.1		355.4
Financial Services (banks, security brokers)	.6	101.7	295.9
Insurance Agents	2.2	92.6	222.5
Real Estate Agents	*		
Wholesale Agents	*		
Miscellaneous Business Services (including Consulting)	1.7	3.2	25.0
Government--Federal, State, Local	4.0	5.1	11.8
Computers and Dataprocessing Service	*	1.9	25.4
	$136.4	$ 213.0	$ 967.5

* No Data Available

Sources: [1] Machlup, F., "The Production and Distribution of Knowledge in the U.S.," 1962 pp. 354-357.

[2] Harvard University, "A Perspective on Informational Resources: The Scope of the program," 1973-74 p. 2.

[3] IC[2] Institute, The University of Texas at Austin, unpublished survey 1985.

and television, photographic equipment, and telephone and telegraph. (See Table 3.)

The lack of economic growth causes several problems: urban decay depressed conditions for economic development; high unemployment, especially among youths, minorities and displaced employees; deficits for all government entities; pressures for protectionism; and particularly, loss of technological leadership and preeminence. To ensure positive economic growth, creative and innovative managers in both the public and private sectors need to collaborate to develop and implement a competitive strategy for managing growth and diversification through technology and commerce. (See Chart B.)

A New Economic Development Strategy

A new strategy is essential because the business climate is hypercompetitive both domestically and internationally. The competition is between countries, states and communities, as well as between large and small firms and among industries. The environment in which start-up and emerging firms must operate is particularly unforgiving. The ability to introduce new technologies or services to the marketplace poses several unique competitive problems.

To help companies meet the challenge of a hypercompetitive environment and to maximize the contributions of the small business and technology business growth sectors to American society, the promotion of new business growth has become an important facet of economic

TABLE 3

Revenue Estimates of U.S. Information Economy
By Information Technology Manufacturing

(in billions of dollars)

	Machlup[1] 1958	Harvard[2] 1970	IC[2] [3] 1983
Printing Machinery	$ .4	$ *	$ 2.1
Musical Instruments	.2	*	*
Motion Picture Apparatus	.1	*	*
Telephone and Telegraph Equipment	1.2	*	13.4
Signaling Devices	.2	*	*
Measuring and Controlling Instruments	5.0	*	7.2
Typewriters	.3	*	*
Electronic Components	*	*	38.7
Other Office Machines and Parts	1.2	*	*
Photographic Equipment	*	*	17.2
Medical Instruments and Supplies	*	*	5.5
Athletic Equipment	*	*	1.4
Computer Equipment and Software	.3	*	44.0
Radio and TV Equipment	*	*	37.9
Numerical Controls	*	*	.2
CAD/CAM	*	*	1.5
Robots	*	*	.2
	$ 8.9	*	$169.3

* No Data Available

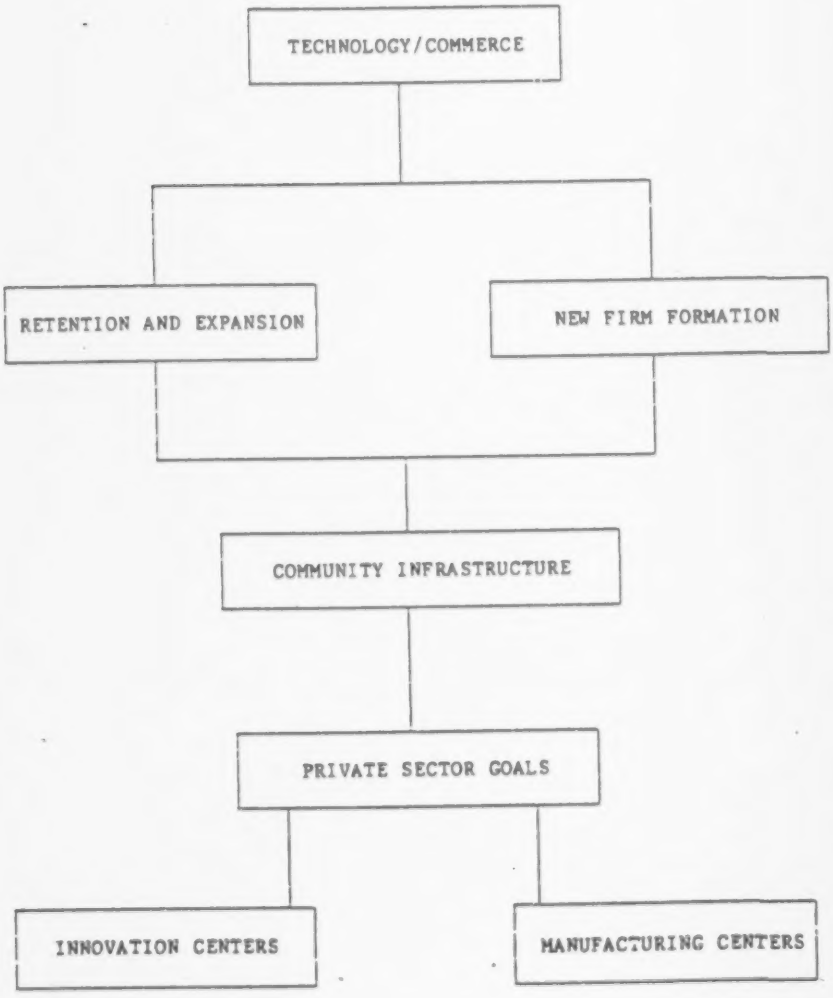
Sources: [1] Machlup, op. cit.

[2] Harvard University, "A Perspective on Informational Resources," loc.cit.

[3] IC[2] Institute, op. cit.

CHART B

OVERVIEW FOSTERING AND MANAGING GROWTH AND DIVERSIFICATION



policy at the federal, state and local levels. Building indigenous companies on the one hand and retaining and expanding firms on the other have become the cornerstones of a competitive strategy for economic development.

Industrial relocation, long the central focus of regional economic development, tends to be a zero-sum game--one region or location benefits only at the expense of another. Indigenous company growth and firm retention and expansion may be a more beneficial and necessary long term economic development strategy for several reasons. First, they harness local entrepreneurial talent. Second, they build companies which in turn create jobs and thus add economic value to a region and community. Third, this strategy keeps home-grown talent--a scarce resource--within the community. Fourth, they encourage economic diversification and technological innovation by creating a climate that rewards productivity and innovation.

Communities must operate in a hypercompetitive environment. There may be as many as 20,000 cities, states and countries competing for less than 1,000 relocations of high technology firms. Consequently, creative and innovative managers concerned about economic development must focus on building indigenous companies and on retaining and expanding firms.

To compete in this kind of environment, creative and innovative managers must stress a community infrastructure that emphasizes a high standard of living and enhances quality of life. This approach con-

veys a recognition of the economic importance of qualitative factors. Some of these are:

*Quality of school	*Ease of transportation within the city
*Quality of parks and playgrounds	*Accessibility of airport
*Outddor recreational opportunities	*Availability of jobs for spouses
*Variety of entertaining activities	*Housing costs
*Cultural events	*As a place to raise children
*Relaxing ambience of community	*As a place to live
*Community safety	*Climate
*Community cleanliness	*Air quality

By stressing the community infrastructure, creative and innovative managers can develop a link among key institutions to build a viable public/private infrastructure, a strong financial environment, a vibrant entrepreneurial spirit, and a commitment and dedication to risk-taking and risk-sharing.

Within this strategy, private sector goals must recognize the need for developing both innovation centers and manufacturing centers. In the past, the emphasis on high technology has led to the growth of high technology companies. Such growth has generally been in communities or regions that have developed centers of innovation. The institutional mix of and required resources and infrastructures for the success of these centers are different from those for manufacturing centers. In the U.S., we have seen two major innovation

centers -- Silicon Valley in California and Route 128 in Massachusetts. These centers place emphasis on those institutions that develop and foster research and development for technological advances and entrepreneurs for building growth companies. The public/private infrastructure in an innovation center emphasizes high technology development for cutting-edge products that result from close customer interface. There are currently a large number of communities in the U.S. trying to develop such centers.

From a global competitive perspective, manufacturing centers are generally found in the Pacific Rim; namely, Japan, South Korea, Hong Kong, and Singapore. Their emphasis is on advanced manufacturing processes for products from high technology that are ready for mass markets both domestically and globally. Currently, they have focused their global marketing efforts on U.S. domestic markets.

Linking these two types of centers, innovation and manufacturing, can provide for more stable and diversified economic growth. To constantly combine high product technology with a high customer interface means that managers must deal with a continuous obsolescence of product life. Furthermore, it allows competitors outside the community and firm to capture the market when the product is in its growth stage through better process and manufacturing technology that lowers the cost and increases product quality.

In the past, U.S. management has emphasized the development of innovation centers while the Pacific Rim nations' firms have empha-

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sized the development of manufacturing centers. Managers in tomorrow's global environment of competition and cooperation will focus on strategies that can link effectively these two types of centers.

Creative and Innovative Management

This linking requires that creative and innovative managers in the public and private sectors think differently about economic growth. A new framework is needed to integrate resource development, economic wealth generation, markets and job creation. The framework must provide insight on those areas requiring creative management, those requiring innovative management, and those requiring creative and innovative management.

Creative management consists of new concepts, new ideas, new methods, new directions, and new modes of operation. The operative word is "new." Innovative management consists of the ability to implement creative ideas and/or move successfully in such new directions. The operative words are "to implement" and "to move successfully." Creative and innovative management focuses on coupling, that is, linking creative and innovative managements. The operative notion here is an "act of management" rather than the act of an individual.

Chart C provides a construct for understanding creative and innovative management. Creative management is what managers of research

CHART C

CONSTRUCT FOR CREATIVE AND INNOVATIVE MANAGEMENT

CONSTRUCT	KEY ELEMENTS
1. Creative Mangement	- New Ideas - New Directions - New Concepts - New Methods - New Modes of Operation
2. Innovative Mangement	- Ability to implement successfully - To move successfully in new directions
3. Creative and Innovative	Acts of management that link together: - Organizational Form - Motivations and Incentives - Culture and Environment - Strategy

and development organizations as well as entrepreneurs deal with -- new things. Innovative management is what entrepreneurs must do especially in the start-up phase and what professional managers deal with in the take-off phase, particularly in marketing, distribution, manufacturing, and finance. Creative and innovative management is the province of the leadership of organizations.

Creative and innovative management implies new managerial practices on the one hand and leadership to implement on the other. Traditional management decision making centered on efficiency and effectiveness. Creative and innovative management focuses on flexibility and adaptability to deal with the process of managing change, including the required public/private infrastructures. It is grounded in the belief that leadership makes a significant difference in the way organizations respond to and cope with change. It is deeply involved with creating real economic value and with adapting the personal aspirations of others to the evolving objectives of the firm and to the larger goals of American society. Creative and innovative management covers the nature of creative and innovative activities, organization design for improving creativity and innovation, organizational creativity and individual personality, creative and innovative management in public sector structures, joint public/private organizations and activities, strategies for academic research and curriculum, and implications for public policy.

Dimensions of Management

Chart D presents a framework for economic growth through technology. It is designed to demonstrate the links that creative and innovative managers must establish to develop and implement a new strategy for successfully cooperating and competing in a hypercompetitive environment. There are four dimensions of managerial relationships that interact simultaneously, as shown in Chart D.

These dimensions are as follows:

I. Research and Development Linkage with Public/Private Infrastructure Institutions.

II. Institutional Functions which Comprise the Infrastructure for Economic Development.

III. Linkages to Support Activities and Entrepreneurial Elements to Innovation and Manufacturing Centers.

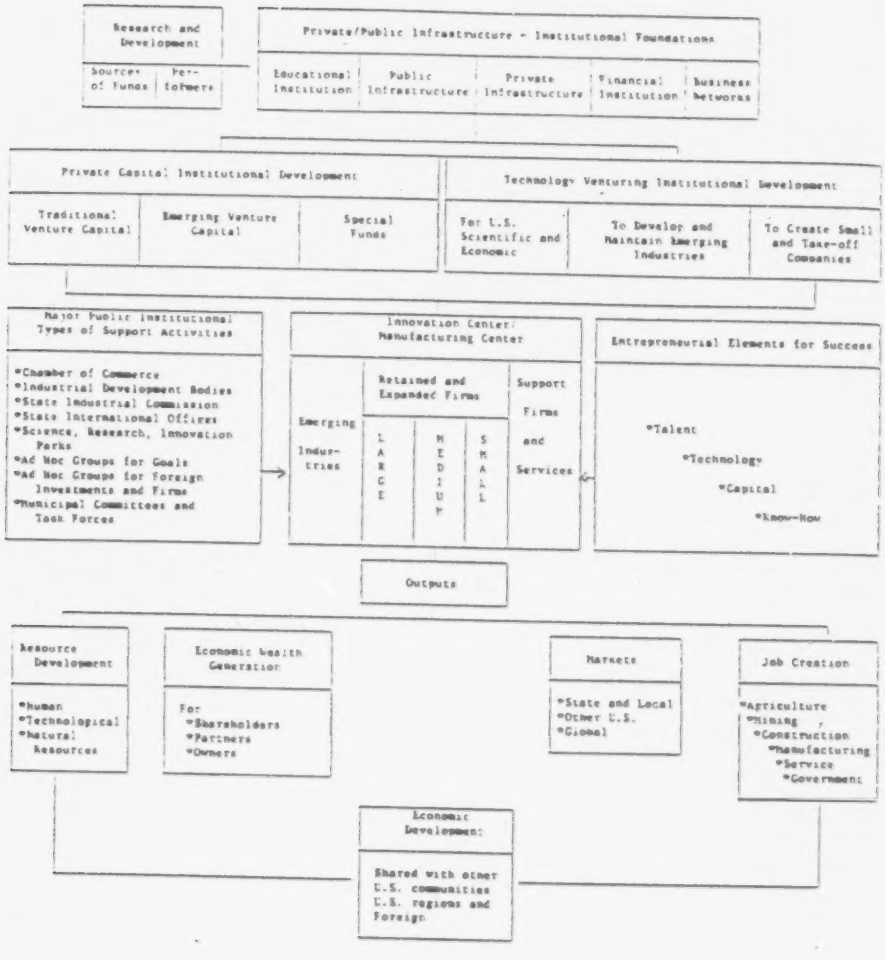
IV. Relationships of Economic Development to Resource Development, Economic Wealth, Markets and Job Creation.

I. R&D Linkages with Public/Private Infrastructure Institutions.

This dimension deals primarily with those relationships that emphasize the elements of creative management. R&D linkages with infrastructure institutions involve new ideas, directions, concepts, methods, and modes of operations. For R&D to occur and then be transferred and diffused for economic growth requires a supportive infrastructure. During the past few years, we have seen the need to

CHART I

A FRAMEWORK FOR ECONOMIC GROWTH THROUGH TECHNOLOGY



create both new types of institutions and newer types of institutional relationships.

Innovative management requires the application of technological advances to generate new products, markets, and jobs. These, in turn, increase productivity, profits, and taxable bases to fulfill public sector responsibilities which contribute to a higher standard of living and quality of life. The interdependence between R&D on the one hand and the public/private infrastructures on the other has profound ramifications for economic growth particularly when there are rapid global technological changes among societies. The specific areas wherein these changes are taking place are shown on Chart E.

As shown in Table 1, R&D has increased in current dollar terms from $11 billion in 1958 to $87 billion in 1983. During 1985, the R&D expenditures increased to over $116 billion. Because of this significant pool of R&D funds, it is important for creative and innovative managers to better design and apply new technologies. R&D activities have become much more geographically disbursed and far more decentralized. As a result, R&D has become a necessary and required stimulant to economic growth across the United States. The transfer and diffusion of technology generated through R&D activities has become the central driver for local and regional economic growth and diversification. Successful transfer and diffusion are the functions of innovative management. In the past, there was sufficient time for the diffusion to take place over a long period of time. Under today's

CHART E

PUBLIC/PRIVATE INFRASTRUCTURE FOR
ECONOMIC GROWTH THROUGH TECHNOLOGY

PRIVATE/PUBLIC INFRASTRUCTURE -				
Eduational Base	Public Infrasturcture	Private Infrastructure	Traditional Financial Institutions	Business Networks
*Elementary *Secondary *Vocational *Higher Education *Continuing Education	*Utilities *Tansportation *Water *Security *Waste Disposal *Quality of life and Environmental Factors *Government Labs *Other	*Service Clubs Trade Associations *Venture Capital *Services and Consulting Legal Accounting Financial Marketing Other *Support Institutions Fabrication Parts and Supplies *Media Info Technology *Affordable Housing	*Commercial Banks *S&Ls *Investment *Banking *Others	*Professional *Ad Hoc Associations *Informal Contacts *Mentors *Business Angels

conditions of viable economic growth, the diffusion must be more rapid. This requires a level of collaborative, innovative managers among those institutions which generate the technology, those which develop new products, and those which provide the infrastructures for enhancing the ability to compete successfully between communities, states, regions, and nations.

For example, the federal government invests over $50 billion a year in R&D. Of this amount, $18 billion are spent in federal laboratories. They employ one out of six of our nation's scientists and engineers. The labs have their own mission, modes of operation, and size. The processes to make the results of their work available to universities and private sector firms are yet to be successfully implemented across the board.

There has been successful transfers to selected industries such as aerospace and electronics. Such transfers have been better between government labs and larger corporations than between the labs and small and medium-size firms. Often, the advances from R&D have been recognized and implemented by other nations' institutions before our own. There are adequate national policies and regulations for such transfers. Increasing the number of successful transfers requires better innovative management and perhaps the development of more innovative institutions for diffusion.

The linkages between university basic research and the private sector are in much the same state as the links for transferring

government lab results. There is a need to extend the abilities of universities to commercialize research and capitalize on intellectual properties.

The linkages are best seen when viewed from a community perspective. Economic growth requires linking the education base with public infrastructure, private infrastructure, traditional financial institutions, and business networks locally, regionally, nationally, and internationally. (See Chart E.) Once again, these linkages can only be accomplished by conscious design and cooperative efforts.

II. Institutional Functions which Comprise the Infrastructure for Economic Growth.

The successful application of technological innovations is a process which is independent of where the innovation is derived be it a firm's R&D, a government-sponsored research project, the intellectual property of a university, an individual inventor, or licensing of foreign patents. Economic growth from technological innovations has become dependent on capital funding. Therefore, capital is a critical infrastructure element.

Capital formation consists of those private capital institutions which have been established to generate profits and those technology venturing institutions establish emerging industries and generate new companies. Chart F details the entities that comprise these types of institutions. There are three types of private capital institutional forms.

CHART F

FRAMEWORK FOR COMMUNITY/REGIONAL ECONOMIC GROWTH THROUGH TECHNOLOGY

Private/Public Infrastructure - Institutional Foundations				
Educational Institution	Public Infrastructure	Private Infrastructure	Financial Institution	Business Networks

Private Capital Institutional Development

Institutional Forms \ Types	Traditional Venture Capital	Emerging Venture Capital	Special Funds
1. Private Partnership	X		
2. Corporate Financial Firms	X		
3. Corporate Industrial Firms	X		
4. Small Business Investment Companies	X		
5. International Venture Capital Companies		X	
6. Business Development Firms		X	
7. R&D Limited Partnerships		X	
8. Leverage Buy Outs			X
9. Mergers and Acquisitions			X

Technology Venturing Institutional Development

Newer Forms \ Purpose	For U.S. Scientific & Economic Preeminance	To Develop and Maintain Emerging Industry	To Create Small and Take-off Companies
1. Industrial R&D Consortia	X	X	
2. Academic & Business Collaborations	X		
3. University/Industry Research & Engineering Centers of Excellence	X		
4. University Intellectual Property Commercialization		X	X
5. Academic/Business/ Government Collaboration		X	
6. Incubators			X
7. Small Business Innovation Research Programs			X
8. State Venture Capital Funds			X
9. Risk Capital Networks			X

Traditional Venture Capital. The traditional capital venture industry consists of private independent partnerships, corporate financial firms, corporate industrial firms, and small business investment companies. This industry can help provide a benchmark as to what technologies are fueling innovation as well as which states are involved in innovative institutional transformations.

The transformation of the venture capital industry started about 1980, if one considers as an arbitrary benchmark $1 billion or more a year of investments. Prior to 1980, the traditional venture capital industry invested less than $1 billion a year.

What is significant is that traditional venture capital is attracted to innovation centers--they go to where the technological excitement is. What is interesting is that these areas of dominance are directly related to R&D developments, which reflect effective linkages in public/private infrastructures; e.g., government, university, and business. In other words, the investments are not necessarily made in the same states from which the pools of capital are formed.

Emerging Venture Capital Sources. This category includes international venture capital companies, business development corporations, and R&D partnerships. These sources did not really takeoff until after 1981.

Business Development Corporations (BDCs) seem to be having a short life. Publicly held BDCs were the result of the Small Business Act

of 1980. Until then, BDCs were private companies with less than 100 shareholders because of the Holding Company Act of 1940. They have become less important in new business growth since the passage of the Deficit Reduction Act of 1984 which taxed their distribution to shareholders as ordinary gains.

R&D Limited Partnerships are experiencing their own transformation from specifically designated projects to professionally managed blind and broadly designated pools. These investments are directed at an earlier stage of innovation than those of the traditional venture capital industry. These investments also provide a window on emerging technologies and their specific commercialization.

International venture capital companies are the fastest growing source of venture capital in the U.S. They comprise some 18% to 20% of the total new investors in venture capital pools.

Special Funds for Financial and Organizational Restructure. A common general characteristic of capital sources for innovation has been the desire for capital gains. This is also the characteristic of special funds. These special funds consist of leveraged buy outs (LBOs) and acquisitions and mergers.

Both the traditional venture capital industry and emerging specialty funds are interested in having their investments become part of LBO and acquisition and merger activities. Many of their investees are also interested in becoming such candidates. Not all start-ups

necessarily stay small or become middle or large size companies that engage in global trade. Many innovators who build companies deliberately plan to "sell out." We are seeing dominant companies invest in the equity of independent growth companies; e.g., IBM, AT&T, GM, Ford, GE, Chevron, etc.

There has been a dramatic transformation recently in the magnitude of leverage buy-outs. LBO investment in principle makes it possible to secure capital gains in less time than investments in start-ups or mezzanine stages of growth companies.

The explosive amount invested for acquisitions and mergers signals another major transformation. Current acquisitions and mergers are, in many respects, different from past periods. In the past, they represented either vertical or horizontal mergers for manufacturing or market control or for financial purposes; e.g., conglomerates. Today's mergers and acquisitions are more for capital gains, increasing managerial effectiveness, or providing investment opportunities that lead to increased liquidity. Many of today's acquisitions and mergers focus on creative and innovative management and on telescoping the time to successfully commercialize innovations because of the accelerated life cycles of newer products, processes, and services.

While a transformation is taking place, in terms of innovation, it has become evident that the present traditional paradigm that science and technology naturally evolve into commercialization that makes and

secures a nation's future is inadequate. It does not adequately (1) provide employment opportunities; (2) mitigate layoffs; (3) maintain a strong global competitive position; (4) make economic security; and (5) present growth opportunities across the board.

The traditional paradigm is undergoing transformation. Emerging institutional developments are leading to a newer paradigm for the commercialization of science and technology within a compressed time frame and a broader base of opportunities; i.e., technology venturing. There is a need for infrastructure reviews to assure that there are no gaps in providing the talent, capital, technology and know-how required for innovation to become diffused to all states. In this regard, there must be available not only excellent schools, transportation, utilities, water, natural resources, and quality of life, but also a vibrant capital environment that provides appropriate institutional segments, savings, in-state markets, business-to-business markets, a regional economic focus, basic research centers supported by federal and state R&D funds, outstanding industrial laboratories, a better educated workforce, including Ph.D.'s and excellently trained workers with advanced skills. There must also be entrepreneurs who are encouraged by local communities, universities and colleges, as well as larger companies.

Technology Venturing Institutional Developments. Technology venturing is a collaborative strategy for economic growth. Never institutional developments are providing a set of coherent relationships

among key institutions involved with economic growth and technological diversification. These institutional developments fill in previous gaps in the traditional venture capital and economic development process.

The drivers for these newer institutional developments are (1) increasing foreign competition; (2) shortages of highly trained scientists and engineers; (3) difficulty in keeping up to date with developments; (4) gaps in new technology transfer, especially when it requires pulling together basic research from different disciplines; (5) a need to fill the gaps for diffusion of technology for developing useful commercial products and services by individual companies; (6) a desire to foster more basic research in universities; and (7) a determination to diffuse R&D activities across wider geographic areas.

At least nine newer institutional developments have been identified. They are:

* industrial R&D joint ventures and consortia
* academic/business collaboration
* government/university/industry collaboration
* incubators
* industry/university research and engineering centers of excellence
* small business innovation research programs
* state venture capital funds

* commercialization of university intellectual property
* risk capital networks

These newer institutional developments have some common elements:

1. They are generally collaborative efforts. In this sense, they are more than partnerships. Partnerships generally mean working together and going along together. In these technology venturing arrangements, each institution has managed to maintain its own independence while providing on a timely and coherent basis for net improvements to the local, state, and national economies.

2. The total funds involved are generally small when compared to more traditional institutional efforts. For example, few states provide as much as $20 million for seed funding for entrepreneurial endeavors. Corporations entering into cooperative technology ventures individually contribute annually in the low millions of dollars per year. Universities' cooperative efforts generally are funded with small amounts per year. For example, the largest biotechnology cooperative agreements we know of between Harvard University and Hoechst amounted to $70 million over a ten-year period. Others are much more modestly funded.

3. Leveraging and institutional coupling are common characteristics. For example, universities are encouraged to

establish centers of excellence with either federal government or state government offering small annual fundings for 3 to 5 years provided their funds are matched to some pre-set ratio by individual business firms. The matching funds are an incentive to provide couplings that are both necessary for commercialization and for reducing the time for commercialization and diffusion.

4. Collaborating institutions are encouraged to utilize existing facilities and to share laboratory equipment.

5. The rights to patents and copyrights have become a newer resource for future funding for some of the institutions involved. The federal government has given the rights to basic research breakthroughs funded under Federal R&D obligations to the performing universities and colleges. This gives them the incentive to convert such technological resources for commercialization through the marketplace and to provide their own flow of future research funds through fees, royalties and other financial forms.

Throughout America, each of the states is moving to aid the growth of high technology and to foster technological commercialization. They, rather than the federal government, have taken a leadership role through policy development organizations, economic growth initiatives, and corporate-university partnerships. Since 1980, over 150 programs or initiatives have been developed by states for high technology and

economic development. For most states, the major source of R&D funds is still the federal government. There is a direct correlation between those states receiving the largest federal obligations for R&D and those taking the lead to initiative technology venturing developments.

As a result of these activities, technopolises are bringing together in dynamic and interactive ways, state government, local government, private corporations, universities, non-profit foundations, and other organizations. They are developing corridors and triangles between key cities or research universities. Centers of excellence are appearing within these corridors and triangles. They have begun to lay out science and research parks; they have begun to target emerging science and technologies for long-term industrial growth and vitality. Leadership networks are forming between previously isolated institutions. The development of such technopolises is not accidental. They can have a catalytic impact and cause reactions far beyond their immediate location within the state. Very often these impacts are national and international in scope.

These states initiatives along with industry cooperatives, and the federal government's Small Business Innovation Research Programs and NSF's Center for Excellence in Science and Engineering have really been focused on covering the gaps in the traditional paradigm of commercializating science and technology. These newer institutional developments for economic growth and diversification are:

(1) developing emerging industries; (2) providing seed capital for early and start-up entrepreneurial endeavors; and (3) assuring U.S. economic preeminence.

Developing emerging industries. Institutional relationships involved here are academic and industrial collaborations and industrial R&D consortia. Because the basic research is carried out in universities and colleges, getting collaborative efforts between academia and industry can accelerate the commercialization of basic research into emerging industries.

Since 1981, there have been a series of private corporation joint research efforts. Examples of pioneering institutions are Semiconductor Research Corporation (SRC), Council for Chemical Research (CCR), Center for Advanced Television Studies (CATS), and Microelectronics and Computer Technology Corporation (MCC). The obstacle to such consortia in the past has been ambiguous legal status under the antitrust laws that would entail the risk of huge penalties. The passage of the Cooperative Research and Development Act in October 1984 has done much to alleviate the legal concerns. A result of the passage of this act has been a proliferation of large-scale R&D consortia which now number over 40 nationwide.

Biotechnology is an example of an important, emerging industry. No U.S. R&D consortium, however, has emerged to compete with the recently formed $100 million, seven-year old Japanese consortium in this area. Most U.S. biotechnology research is being conducted by

individual firms or by establishing university-corporate relations. Some of the more recent start-up biotechnology companies have had as equity shareholders other major firms in energy, drugs, and agriculture.

Newer institutional structures are emerging in the "megabuilding business." These structures include other domestic and foreign support and process companies as well as domestic and foreign governments. Innovative financing is required that pulls together banks, institutional investors, government financial export credit agencies, and international development organizations, such as the World Bank and International Monetary Fund. In addition, megabuilding institutions are required to make their own investments in the projects, carry on basic, generic and engineering research, and keep up with technological advances in new materials, products and processes. Their marketing strategy includes more than competitive winning of contracts. It involves the ability to do longer-range planning and forecasting of markets and to generate new businesses based on commercial-size demonstration plants.

Providing seed capital for small and take-off companies. Some forms of institutional development such as incubators, SBIR programs, state venture capital funds, and risk capital networks are providing seed capital for small and take-off companies. They are also pushing regional and local economic diversification through entrepreneurial activities.

A number of states are now developing special initiatives, such as tax incentives, enterprise zones, research and industrial parks, and direct financial assistance in the form of low-interest bank loans and loan guarantees to meet the start-up capital needs of new technology firms.

One area of concentrated interest is state support and implementation of private venture capital sources for small technology firms. Given the high risk and generally long-term pay-back time of typical venture capital investments, firms with less than $500,000 "start-up needs" are not attractive investment targets for the private market.

A fine example of state involvement in this area is the Massachusetts Technology Development Corporation. Operating both as a public agency and non-profit corporation since 1979, the MTDC has invested $3.4 million of its own funds into 20 individual firms. More dramatically, it has used these investments to leverage more than $22 million in private sector money to these same companies.

A creative approach was taken in 1982 by the Michigan Legislature which permitted the use of Michigan State Retirement Funds to be used as a venture capital base for equity investments in Michigan high technology firms. The estimated value of these venture funds is $350 million.

Incubators are another promising tool being employed to provide a suitable environment for "hatching" new spinoff applications of high

technology ventures. These are funded by both public and private sources. There are about 150 incubators across the country. The great majority have sprung up since 1983. In addition to seed fund programs and incubators, a number of states have established training and support programs for entrepreneurial development, feeling that this is one of the most critical areas in promoting technology commercialization.

Risk capital networks are structured to organize the capital pools held by individual investors. These individuals are generally known as "business angels" and make nominal investments in newer and emerging companies. Their major motivation is a kind of psychic income: putting resources back into their communities for economic growth.

Assuming U.S. economic preeminence. A number of institutional developments are seeking to ensure U.S. economic preeminence. These focus on the creation of NSF centers of research and engineering excellence, government/business/university collaborative arrangements in technological areas, industrial R&D joint ventures and consortia, and NSF's sponsorship of Industry/University Cooperative Research Centers (IUCR). These are intended to provide a broad-based research program that is too large for any one company to undertake alone. Most of these centers are for multidisciplinary research programs to meet industry's research needs. To date, 20 such centers have been established with 10 more in the planning stage. Twenty states are

involved. Massachusetts leads with four. Those states that have three centers are North Carolina, Pennsylvania, and Ohio. New Jersey, Georgia, and Texas have two centers each. The 20 university centers now in operation involve 250 faculty members, 300 graduate students, and 30 post-doctoral students. There are 150 industrial members who have invested $25 million since 1972, with $10 million of that total coming in 1984.

There are four supercomputer/university consortia which are funded by NSF as well as the Florida State Unviersity Supercomputer Computation Research Institute. There are also various universities that have formed consortia for undertaking scientific research that requires the scientific resources of more than one university.

Much remains to be done in the new frontier of technology venturing. There is little question but that these newer institutional developments have their own momentum. How effective they will be is yet to be assessed.

Success in those technology venturing institutional forms depends on the creative and innovative managers of the institutions involved. Through acts of management, they must link together organizational forms, motivations and incentives, cultures and environments, and strategy.

III. Linkages of Support Activities and Entrepreneurial Elements to Innovative and Manufacturing Centers

Innovation and manufacturing centers are the results of linking major support activities and entrepreneurial elements to develop and enhance new and existing firms, and to develop emerging industries. The major support activities consist of formally constituted state, local and private agencies such as chambers of commerce, industrial development bodies or commissions, international offices, and formal science, research and innovation parks, as well as informal groups such as ad hoc groups for goals, foreign investments and future oriented task forces. The entrepreneurial elements are talent, technology, capital and know-how. (See Chart D).

In many respects, how well these linkages are managed will determine the pace at which innovation centers, manufacturing centers and innovation/manufacturing centers are developed. Raising the productive use of the resources available for development to the point where it meets the human needs of the society or community is the major purpose of economic development. Human needs result from such factors as degenerating physical infrastructure, loss of business and jobs, and inability to raise revenues to match expenditures and newer investment needs of the community.

The first dimension of R&D linkages with public/private infrastructure emphasized creative management, i.e., new. The second dimension of infrastructure institutional functions for economic growth emphasized the need for innovative management, especially in transforming sources of capital. The transformation involved two

bases for increasing economic development, one for private capital development and the other for technology venturing development. Here the emphasis is on innovative management abilities to implement successfully (private capital development) as well as to move successfully in new directions (technology venturing).

Strategy and Economic Development

Successfully linking support activities and entrepreneurial elements require creative and innovative management. These are acts of management rather than the individual efforts of leaders or mentors. One of the key elements in the construct of creative and innovative management in Chart C that is necessary for the successful linkage and implementation in building innovation and manufacturing centers is strategy. Forward looking leaders of all sectors in the community readily recognize that economic development problems cannot be solved in a short time. There is no quick and easy responses to various crisis. Strategic planning involving the managers of public/private sector organizations is necessary to determine the multi-related requirements for innovation/manufacturing centers, the resources needed, and development of both short- and long-term action plans necessary to accomplish goals. Strategic planning for the development of innovation/manufacturing centers involves:

1. Focused process for selecting goals;
2. Consideration of resources available as well as the required development of necessary resources;

3. Consideration of major external events or changes; and
4. Action orientation with a strong emphasis on successful results.

Successful strategic planning depends on the linking major support activities and entrepreneurial elements with innovation centers and manufacturing centers. This process includes:

1. Organizing the various institutions;
2. Identifying the key issues;
3. Analyzing key issues;
4. Defining goals and objectives;
5. Developing appropriate strategy;
6. Developing workable operational plans; and
7. Implementing, updating, and monitoring the operational plans.

Economic development as a creative and innovative managerial activity is based on linking four critical factors:

1. talent -- people;
2. technology -- ideas;
3. capital -- resources; and
4. know-how -- knowledge.

Entrepreneurial talent results from the drive, tenacity, dedication, and hard work of special types of individuals--people who make things happen. Entrepreneurs are individuals who recognize opportunities. Where there is a pool of such talented entrepreneurial personnel, there is the opportunity for growth, diversification, and new

business development. There are a variety of sources for entrepreneurs: universities, corporations, research labs, communities, the public sector and inventors of all sorts. Events that trigger their entrepreneurial push may include dissatisfaction with current employment, recognition of an opportunity, an urge to try a new venture, changes in public policy or simply a desire to push an innovative idea.

But talent without ideas is like seed without water. The second critical component in the entrepreneurial process concerns the ability to generate ideas that have real potential within a reasonable time. The burst of creativity and innovation in emerging technological industries holds tremendous promise for economic development and technology business growth. When talent is linked with technology, that is when people recognize and then push viable ideas, then the entrepreneurial process is underway. Every dynamic process needs to be fueled. The fuel for the entrepreneurial process is capital. Capital is the catalyst in the entrepreneurial chain reaction. It is the life blood of emerging and expanding enterprises. It is the sine qua non in business of a new product, an innovative service, or a brilliant idea. It provides the financial resource through which the ideas of the entrepreneur can be realized.

Given talent, technology and capital, one other element is indispensible to making the entrepreneurial process successful. Know-how is the ability to leverage business or scientific knowledge in

linking talent, technology and capital in emerging and expanding enterprises. It is the abiity to find and apply expertise in a variety of areas that can make the difference between success and failure. This expertise may involve management, marketing, finance, accounting, production and manufacturing, as well as legal, scientific and engineering help.

Before going to the fourth dimension, it may be useful to discuss briefly the requirements of successfully linking the above three dimensions of (1) R&D developments with public/private infrastructure; (2) institutional functions for economic development; and (3) support activities and entrepreneurial elements to innovation and manufacturing centers. As noted previously, the first dimension required emphasis on creative management, the second on innovative management and the third on creative and innovative management. The requirements for successfully initiating the linkage of these dimensions are:

1. Need -- Is there motivation for pride, security, and profit?
2. Vision -- Are there adequate mentors to foster the program as well as recognized leadership to embrace the vision?
3. Timing;
4. Technical feasibility -- Does the technology exist? Is the required research underway?
5. Skilled personnel -- Is there sufficient quantity?
6. Leadership -- Is management available and in place?

7. Adequate financial resource;
8. Public and political support;
9. Public/private sector cooperation; and
10. Intellectual community support.

Successful economic development usually takes longer and costs more than anticipated; and failures will sure occur along the way. Consequently, there needs to be:

1. Continuity of public and private support;
2. Capital infusion;
3. Parallel developments to alternative approaches and supporting technology;
4. More skilled personnel than originally planned;
5. The need for evolving managers in all involved institutions through:
   a. Creative management -- to start.
   b. Innovation management -- to move forward.
   c. Creative and innovative management -- to finish.

IV. Relationships of Economic Wealth Generation and Resource Development, Markets and Job Creation.

The output of innovation and manufacturing centers generates economic wealth primarily for their shareholders, partners and owners. Of course, others also benefit by their economic growth, including their employees, creditors and community infrastructural institutions.

They also help provide revenues both directly and indirectly for the traditional tax bases such as sales, property and income for the public sector infrastructure institutions.

Traditional theoretical approaches to economic development have concentrated upon the accumulation of capital as a basis for increases in productivity. Newer work has cast doubt that growth of capital alone can account for the increase in overall productivity. Productivity increases depend in very large part on technological change. Therefore, technological advances are the key driving force in increases in productivity which in turn generates wealth.

Capital investment on a large scale may be needed to put new technology to use, particularly when a nation, region or community is in a period of transformation. This was the case of Japan and West Germany in the post World War II period. In many respects, this is how the case in the U.S. Today's U.S. economy and that for the 1990s requires extensive capital investments by each sector of our economy. As illustrated in Chart D, each of these sectors is involved with economic development and growth. Their interdependent linkages are requiring longer-term capital commitments in response to the changing worldwide hypercompetitive economy. It is not surprising that federal, state and local governments, businesses, and universities are all making investments simultaneously to transform our older economic structure to enhance its technologically competitiveness. In other words, if we are to have a viable economy in the 1990s and beyond,

many investments will have to be undertaken in parallel to support the required industrial, public and educational infrastructures.

The relationships between economic wealth generation and resource development, markets and job creation involve more than making economical capital investments. Just as important as the usual economic standards of effectiveness and efficiency are two other dimensions. First, flexibility. If we do not make the investments will we still have sufficient flexibility to meet competitive challenges, foreign or domestic? Second, adaptability. If we do not make these investments, can we adapt ourselves to unexpected or unforeseen competition without serious consequences to our firms and communities? These are the questions that the newer economic development strategy raises.

Resource Development. Resources for some time have been the "stepchild of economic thought." They are, to a large extent, the product of human creation. They are more than a thing or a substance. They are the means of attaining given ends. In other words, as means, they are instrumental in attaining economic wealth.

The technologies for the 1980s and 1990s must be viewed as a national and a world resource, as a generator of economic wealth, as the means to increase productivity and international trade, as an area for assessment of public and private risk taking and risk sharing, and as an influencing factor for changes in the organization, education and training of the workforce.

First, technology is not simply an engineering "thing," a gadget or even a "process" It is a national and regional resource. Unlike natural and human resources, it is not consumed in the process of use. Rather, like a catalyst, it can be a stimulant, or it can be self-generating as in fusion. The use of technology actually creates more technology. There is, however, no systematic means for allocating or evaluating technology as a resource. Today, we cannot tell whether the allocation function is efficient or inefficient; or even if it is working and meeting the objectives for which it was created let alone the needs of society or our individual institutions.

Second, technology is a type of wealth; one which we do not yet know how to measure for economic purposes. Since we cannot measure technology as an economic resource, our ability to determine its full value is limited. Wealth, of course, is a means of attaining economic, social and cultural status for individuals as well as a way of achieving institutional objectives and the general welfare of society. It is recognized as perhaps the single most important variable in determining an individual's, corporation's, nation's, state's or locality's alternatives. Wealth is the key to power in any political system. Its ownership, control, and transformation determine not only the structure of society but also the success or failure of the system itself. To ensure the continued strength of our economic and political systems in terms of our current institutions, we need to develop ways of estimating the real wealth, that is, the productive wealth, provided by new and improved technologies.

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Third, technological innovation is a prime factor in stimulating our productive capacity and insuring healthy competitive international trade. We must, therefore, adopt viable national and state policies for technological development. Thus far, few if any nations, have effectively formulated such critical policies. We can bring about significant short-term as well as long-term gains by encouraging the establishment of an effective working relationship between government, business and universities regionally, nationally and internationally in order to strengthen and broaden our R&D environment. Government can be a very important stimulant to technological development. By developing policies that encourage academic and industrial research, strengthen the educational structure, promote a positive business and economic climate, and identify special areas of concern, government can be a positive force in technological growth.

Fourth, the relationship between the public and private sectors is changing. Each nation's technological needs are linked with other nations' commerce in a number of important ways. In no case is one market wholly insulated from what happens in other countries. This is a fundamental political and economic fact. Shortages can result in a crisis, a comfort, or a boon depending on the circumstances. Some shortages can produce a crisis of national or regional consequences. To reduce the consequences of the crisis puts us in the arena of potential "public risk" taking. When such an event threatens national or regional stable economic growth there is a "public risk." Investments in some critical technological areas may be so large that

the private sector alone is unable to assume the potential risks. It is appropriate to consider the risk involved as a possible public venture to be implemented as well as supplemented by our private firms.

Education is key in the development of all resources -- human, natural, and technological. We know that how these resources are managed does make a difference. From a relationship perspective, it is important to consider the following propositions:

1. Managers who succeed are those who feel strong needs for achievements. This requires talent as well as education and experience as discussed in dimension three -- linkages of support activities and entrepreneurial elements to innovation and manufacturing centers.

2. Managers must possess specific knowledge and skills related to both technologies and the functions of management as covered in dimension two -- institutional functions which comprise the infrastructure for economic development.

3. Managers who succeed are dependent on the support they receive from the infrastructures as discussed in dimension one -- research and development linkage with public/private infrastructure institutions.

The critical aspect about resource development for economic growth is that such resources can be shared and exploited by others than those who are directly responsible for their development. For

example, technological resources can be transferred for economic development purposes from government labs or universities in one community to others in the same state, other states or other nations. They can also be diffused geographically and thereby enhance competition.

Markets. Today markets are worlowide; they are not limited to a local community. These markets are developed in response to individual needs and social wants.

The U.S. no longer controls the world markets, even though we are the largest consumer. In fact, the President's Commission on Industrial Competitiveness has referred to this market challenge as "Competitveness: The Quiet Challenge." Their definition of competitiveness is as follows:

> "Competitiveness is the degree to which a nation can, under free and fair market conditions, produce goods and services that meet the test of international markets while simultaneously maintaining or expanding the real incomes of its citizens."

According to the Commission,

1. Competitiveness is not a winner-take-all game -- all nations should benefit from the economic growth of a healthy world.

2. Competitiveness is not an end in itself; it is a means to an end. The end is a high standard of living and the growing wealth that allows the attainment of other goals such as

employment opportunities, domestic services, and national securities.

3. Competitiveness does not require American leadership in all economic sectors. Yet the U.S. should maintain a broad and diverse industrial base that allows for the creation and full development of new technologies and markets.

The Commission made four policy recommendations directed related to our framework for creative and innovative management:

1. Create, apply and protect technology;
2. Reduce the cost of capital to American industry;
3. Develop a more skilled, flexible and motivated workforce; and
4. Make trade a national priority.

Job Creation. The cycle of creation of products and services begins with basic research and ends with their entering the marketplace. To date American management has been very effective in the innovation of new products and services based on high technology. We have been less so in the area of manufacturing and world distribution of products and services for worldwide markets.

The results of our current competitiveness posture on employment are well known. Namely, we are encouraging innovative employment, particularly in small and medium-sized firms. The service sector industries have also provided for increased employment. Meanwhile, employment is being permanently lost in basic industries, agriculture and government sectors.

Technological progress and job creation are interrelated by the role of human capital in economic development. One way to improve the quality of labor is to invest in education and training. Society's stock of technology and know-how is not transmitted by educational infrastructure alone. Nobel Prize winner Herbert A. Simon has written that the availability technologies to youth is its own instructor. In other words, hands-on experience on available technological capital at school, at work and at play helps in transforming human capital. Other means of improving human capital is to improve health. Still other ways exist including flexible work hours, children care centers, etc.

There is a need to recognize that entrepreneurship which primarily creates innovative centers is no longer enough to succeed in a highly competitive world market. Creative managers and innovative managers must be transformed into creative and innovative managers to develop products and services that our firms can produce and sell more efficiently than our global competitors. Our ability to compete successfully will require a newer order of collaboration and cooperation around institutions and organizations that comprise our public/private infrastructures.

The CHAIRMAN. Thank you very much. We are going to withhold questions for now.

Mr. Samuel.

Mr. SAMUEL. I will take your statement seriously about summarizing my statement in order to have time for questions.

My name is Howard Samuel. I am the President of the Industrial Union Department of the AFL-CIO. We represent 54 national and international unions and five million workers.

Our members are directly on the cutting edge of the devastation of the American industrial sector, stemming from rising trade deficits and declining U.S. competitiveness. As part of our effort to turn around the grim realities facing America and its industrial base, we work very closely with the entire U.S. labor movement and our member unions. We also, however, reach out to concerned parties such as the business leaders who have worked to improve our trade position in the Labor-Industry Coalition for International Trade, or LICIT, which I co-chair, and more recently through the Council on Competitiveness, on which I serve as a vice-chair.

From a labor perspective, the overriding reason for concern about our economy is jobs, both their number and their quality. And the fact is that America's job position is declining in both number and quality. Unemployment is at the highest level of any postwar recovery and poverty has returned to the levels that prevailed before we began the War on Poverty 20 years ago.

In the midst of boasts from some quarters of the success of the "great American jobs machine," our industrial sector has seen massive job loss and net employment decline. America's industrial sector has lost two million production jobs net since 1979. Our national trade deficit of some $170 billion this year itself contains the equivalent of 4¼ million jobs lost, the bulk of them in the manufacturing sector. The conclusion is plain that the jobs implications of the trade deficit alone are enough to account for the declining number of good industrial jobs in America and the parallel decline of our major industries.

Mr. Chairman, our concern is not just with the quantity of jobs, but with their quality. And the story on U.S. job quality in the 1980s is profoundly disturbing. The decline in American living standards has been well documented on Capitol Hill over the last year, particularly through research for the Joint Economic Committee. We know that the average weekly earnings of American workers, corrected for inflation, are declining and are today 14 percent lower than they were in 1973. Indeed, they have declined to the level of 1960 or 1961 in real purchasing power. This is a startling reversal of the long-term trend of a steadily increasing standard of living for American workers.

The distribution of income and opportunities in the jobs America has been creating since 1979 is equally disturbing. The seven million newly created jobs mask the fact that, as shown in research carried out by our organization, the IUD, we have lost 2.3 million good jobs in manufacturing and better paying services related to infrastructure and production and we have gained 9.2 million jobs generally in the lower paying service industries. A third of these new jobs are part-time.

Numerically, the 2.3 millions jobs lost paid an average of $444 a week—that is in 1985 dollars—while the new jobs created pay an average $272 a week or 40 percent less. For the first time since the Great Depression, most of the new jobs being created indeed pay below the level needed to sustain a family above the poverty level.

What are the solutions that will meet these unprecedented challenges to American society and the American economy? While the complete answer which I think was discussed earlier in this hearing is one which may take years to develop, there are several steps we can take for urgent near-term action, and I suspect, Mr. Chairman, that those of us looking at this issue of competitiveness are a little bit like the old Indian fairy story about the blind men looking at the elephant for the first time, or at least touching the elephant for the first time.

As each touched a part of the elephant, they got a different idea of what the elephant looked like. Holding the tail, it seemed like a snake. Holding the elephant's leg, it looked a trunk of a tree or seemed to be like the trunk of a tree.

I do not want to suggest that I suffer from any kind of myopia, but I would like to suggest three areas which we think are particularly important.

The first urgent priority and one that I hope Congress and the President can move on very quickly is to overhaul and specifically to modernize our country's outdated trade laws. No matter what steps are taken to upgrade the competitive abilities of American industries, if our trade laws and our government are not competitive in defending and promoting our industries in international competition, those efforts will not succeed.

A second area where action will hopefully be taken quickly involves promoting the adjustment of workers dislocated by plant closings. According to studies by the Bureau of Labor Statistics, GAO, and the Office of Technology Assessment, over two million workers annually lose their jobs because of plant closings or permanent layoffs.

For the last year I have served as a member of the Department of Labor Task Force on Economic Adjustment and Worker Dislocation which last week issued its final report. The Task Force calls for setting up a program of upwards of $900 million to develop a rapid response capability in each State to meet the needs of those dislocated workers and to promote their rapid reemployment in appropriate jobs.

The report notes that advance notice is "essential for the development of successful adjustment programs" and also that notice is not harmful to employers, and indeed it may be helpful in some cases. Government research indicates that most workers do not receive adequate notice of the elimination of their jobs.

We hope that legislation incorporating a rapid response mechanism, support for training where appropriate, income support for those undergoing training, and adequate advance notice will be sent forward to the President as soon as possible.

The President's Commission on Industrial Competitiveness dealt with a number of other issues which will also occupy the new Council on Competitiveness beyond international trade and dislocated workers. These include such issues as the cost of capital, the

need for expanded research and development, and the upgrading of our educational system.

Linking all of these concerns is an overriding issue which the President's Commission dealt with. That is the need for harnessing the best thinking of all sectors of our economy in working jointly towards solutions that can be effective. The President's Commission called for the development of tripartite committees—participation by industry and labor with government in developing policy and program initiatives.

Traditionally in this country, we point to our history of adversarial relations between business and government and between labor and management. Today, in addressing these issues of national urgency, the various parts of our society need to be pulling in the same direction if we are to have a positive result. It is my hope and recommendation that participative tripartite forums be an integral part of our national efforts toward improved competitiveness.

Mr. Chairman, I would like to close my comments by quoting a couple of sentences or paragraphs from the Final Report of the President's Commission which I think should be kept carefully in mind as we deal with the issue of competitiveness.

One is the President's Commission's definition of what competitive means. And I quote: "Competitiveness is the degree to which a nation can, under free and fair market conditions, produce goods and services that meet the test of international markets while simultaneously maintaining or expanding the real incomes of its citizens."

This definition shows the stakes involved. Our ability to compete in world markets is the very foundation of our rising standard of living. "It is not our goal" and I am reading now from the report—"It is not our goal to compete by decreasing the real incomes of our people. Other nations may compete by having low wage levels, but that is not an option America would choose. The challenge then is to maintain our high standard of living in an increasingly competitive world environment. Competitiveness is not an end in itself. It is a means to an end. Competitiveness means a high standard of living and the growing wealth that allows us to attain other vital national goals, employment opportunities for our people, and the domestic services and national security our government provides."

I think these words from the statement of the President's Commission serve as a good preamble to any work that this committee chooses to do. And I thank you for this opportunity.

The CHAIRMAN. Thank you very much, Mr. Samuel.

Dr. Cyert.

Dr. CYERT. Thank you, Mr. Chairman. I will also try to summarize my thoughts on this in a similar time period.

My statement is an attempt to try to understand of what we are experiencing and why we are experiencing it.

The fear about competitiveness is, of course, real. We know that we have lost our position in a tremendous number of industries. In the Pittsburgh area in particular, we have read about the closings of steel mills and unemployment and we know what has been happening in textiles and automobiles and other industries.

Now, there are a number of reasons for this, some of which have to do with the question of competitiveness. I would say there are

three basic factors that have really accounted for what we are seeing. One is the fact that we do have an economy that has been internationalized. This is a trivial point. Everybody now recognizes this.

The second point is the relative cost position of Americam firms in the various products that they produce.

The third, which has not really gotten the attention is the fact that what we are involved in is really a knowledge revolution and that this knowledge spreads rapidly throughout the world. And this area of knowledge has been our primary comparative advantage.

Now, how do we tie these things together? I think we suffer in terms of the internationalization of the world market because for a long time our managers really believed that the American market was not vulnerable to foreign competition. As a result, our industries or firms became lax in controlling costs, and that factor has made us more vulnerable.

This laxness has led management and labor in many cases to have wages go higher than appropriate on the basis of productivity. Further, despite our business schools and their high quality, we have not been innovative enough in management. We have not been innovative enough to keep up with the Japanese who have in many areas really gone beyond anything that we thought was possible. I am particularly thinking of the whole area of inventory control where we were very advanced using statistical, and optimization techniques. We felt that if we could reduce average inventories in our firms by 25 percent, it was a tremendous improvement.

None of us thought that it was possible to go to zero inventories, but the Japanese have done it. We were not innovative enough. We have to recognize that we were deficient. Part of this again came from the fact that we were somewhat smug about the American market.

We are now in a situation I think where our product costs are higher than our competitors. Our productivity does not make up for the higher labor costs. I would like to correct some points which I think underlie some statements that have been made here earlier about productivity. And this is something that I think you have to be careful about in this field.

You have to watch aggregate figures. It is true that productivity has slowed down since 1979 in American industry if you take the overall productivity figures. If you break them down, however, it appears that this slowdown was really concentrated in some nonmanufacturing industries. If you look at manufacturing productivity during the 1975-80 period, it has been growing rapidly and actually exceeds the average growth rates that have been observed previously during the postwar period.

However, we still are relatively high cost, in part because wages have been increased beyond productivity; in part because our management has not been able to control overhead to the point where it can balance out higher production costs. We therefore, have gotten ourselves, the higher exchange rates have been an exacerbating factor into a position where we are not competitive intentionally in many industries.

Now, the major factor that I want to emphasize is the rapid dissemination of knowledge. I think that our hope to be more competitive in this country is the use of our superior technical knowledge. We are able to automate our production processes because of our vast superiority in computers. And I might emphasize here also that a good bit of our superiority in the computer area comes from Department of Defense investment research projects on computers.

Carnegie-Mellon University, MIT, and Stanford have the three leading computer science departments in the country. They have them because they were in computers early and because DoD supported them significantly. NSF did not have the resources in the 1950s and 1960s to build strength in computer science. The U.S. owes its superiority in computers, some people in the computer industry might not agree, to the kind of investment that was made by the Department of Defense in computers.

What we need to do in my view is summarized by the slogan which goes around in manufacturing firms and that is "Automate, emigrate, or evaporate." In other words, you have got to automate. If you cannot automate, them move out of the country to some low cost area. Your third alternative is to go out of business, to evaporate. This slogan has summarized the strategic thinking of a lot of American industry.

Clearly what we want to see is American firms investing more in automation. We have the opportunity, in my view to really be the leader in automated production methods because of our superiority in computers.

You have heard a lot perhaps about the so-called fifth generation computers in Japan. That whole area is pretty much a myth. The Japanese fifth generation computer project is not one that has been successful. I was there. We were able to view what was going on. Later that night I had dinner with some Japanese industrialists and they agreed with the assessment that fifth generation project is more talk than substance.

I think we do have superiority of knowledge and what we need is greater will to move into automated production processes. We need to move toward a position where we are closer to having unmanned factories.

Now, this does not mean that we should be thoughtless or care little about what happens with the work force. The real reason for our having to move as rapidly and as vigorously as we can into this area is to save jobs for this country. If we can become competitive through this greater knowledge, then jobs that would have disappeared are going to stay here. If we are successful we will capture more of the world's market, and as we do that, we are going to save jobs.

Now, there is no question, however, that we are not as we move forward going to have the same proportion of our labor force in manufacturing as we have had previously. We are going through the same kind of a process in manufacturing that we went through in agriculture. In 1900 we had 50-percent of the labor force in agriculture. In 1980 it was around 4 percent, and it is less than that now.

We had 22 percent of the labor force in 1979 in manufacturing, and that is going to be reduced as we move forward. We must, as

this reduction takes place, pay attention to things like training, and we must be in a position to see that the quality of jobs in other sectors of the economy are of sufficient value and sufficient quality, so that the American worker does not suffer. The transition must be humane.

But the point that I want to make on this is that because of the rapid dissemination of knowledge, even though we can have some advantages, we have to face the fact that these advantages are going to be temporary. We are in a position in the world where knowledge is spreading rapidly and no nation—and I agree with the point that my colleague Dr. Kozmetsky made here—no one country can have a comparative advantage indefinitely.

The process of economic development will be characterized by a ratchet effect. We will have an advantage for a little while as we do, say, in computers. The knowledge spreads around the world, and we lose the advantage. We must have a pool of knowledge that we can then dip into and use that knowledge to again develop some comparative advantages. But the future of the country in the manufacturing area lies in our ability to utilize the knowledge that comes from research by applying that knowledge to products and manufacturing processes.

Now, I think we have got a lot of things in place, but to concentrate, for this committee to concentrate on competitiveness I think it does have to look at what are we doing in terms of developing that pool of knowledge, what are we doing in terms of seeing that that knowledge is applied? When we can really operate at a very high level in these areas, then I believe that America will be competitive and that we will again be the greatest manufacturing nation in the world.

Thank you.

[The statement follows:]

STATEMENT OF DR. RICHARD M. CYERT

THE NEW COMPETITION

The economy over the last ten years or so has been subjected to a large number of major shocks. We have had high inflation; we have had strong efforts to control that inflation; we have had a period of low inflation; we have had high exchange rates which have resulted in tremendous imports; we have had a fall in that exchange rate; we have had de-regulation in some significant industries, we have had a major growth in venture capital and, as a result, large numbers of new firms are being started. We have had a wave of takeovers that have resulted in a large number of mergers. Undoubtedly, there are other major shocks to the system that could be enumerated.

In trying to analyze what has been happening to the structure to the American economy, it is useful to distinguish those factors that are the result of variables stemming from international activity from those that are purely domestic.

The most fundamental variables at work, in my view, are in the international sector. These forces are having an important impact on the American economy and are forcing a major restructuring of the manufacturing sector. These forces have been at work for the last ten years and have been most obvious in the steel and automobile industries, but, in fact, have made an impact on a large number of industries in many geographical areas of the country.

Basically, the impact from the international forces stems from three factors: (1) The internationalization of the economy, (2) The relative cost position of American firms, and (3) The rapid spread of knowledge throughout the world.

The American economy is certainly the freest major market in the world. We have fewer restrictions on foreign trade than any country in the world. As a result, it is possible for most foreign companies to bring their products to market in the

U.S. This condition has helped increase our standard of living. However, the power of foreign countries to compete successfully with American corporations has changed in recent years.

Part of the difficulty with American corporations stems from the fact that they treated the American market as the sole province of American corporations. As a result, many policies, in particular labor-management relations, were developed with the implicit assumption that American firms did not have to worry about foreign competition in American markets. The reasons for this view, in part, were the poor quality of foreign products and the high cost of transportation.

This reasoning, however, is no longer valid. The foreign countries have been able to do an outstanding job in designing new products and in improving the quality of products. In addition, transportation costs have decreased significantly.

Unfortunately, our assumption of the American market not being vulnerable to foreign competition has allowed us to be law in controlling costs, and that factor has made us more vulnerable. This laxness has led management to allow wages to go higher than appropriate on the basis on productivity. Further, despite our business schools and their high quality, we have not developed the innovations in management that would have enabled us to keep pace with the Japanese.

The net result of the laxness in cost control and the lack of innovation in management has been to put the American corporation at a relative cost disadvantage with most foreign countries. We are in a situation in which out labor costs are higher than our competitors'. Our productivity does not make up for the higher labor costs. In fact, it may not be as high as the foreign workers', and our management methods have not been about to lower overhead to the point where it balances out the higher production costs. To say that American industry is in a relatively higher cost position also implies that the quality of the products of America do not compensate for the higher costs. This higher cost was exacerbated by the high foreign exchange rate that persisted until fairly recently. Thus, with the two factors together, the high cost and the high exchange rate, U.S. industry was basically not competitive in the international economic environment of our economy.

The third factor is the rapid dissemination of knowledge. This is an important factor that has not been fully recognized in the world. We have long talked about the world shrinking and becoming one world. In the field of knowledge, we are perhaps closer to this state than anywhere else. Through our universities and through our technological advances in communication, we are in a position where knowledge is spread around the world rapidly. At one time, the United States had a dominant position in technical knowledge. It knew how to produce steel, automobiles, and many other products better than any other ecountry.

However, increased communications and improved transportation led to the worldwide dissemination of technical knowledge about the methods of production for many of basic commodities. Indeed, the United States, being an open society, has fostered the spread of knowledge.

This transfer of knowledge is tending to equalize living standards around the world. Although the process is a slow one—and not every country or segment of the world will share in it—it is underway and affecting the U.S. economy. The foreign countries have been able to improve their standards of living through the development of new industries that successfuliy compete in the U.S. market while the U.S., as we have shown, is losing its manufacturing industries to countries with lower production costs.

The best solution, in my view, to the manufacturing dilemma and one that only a few companies have attempted so far, is the automation of the production process. We must substitute capital for labor. The United States has a comparative advantage in the former, but not in the latter. Improvements in manufacturing processes will provide the capability to ensure the production of consistently high-quality goods, the ability to make cost-effective products, and the flexibility to respond rapidly to changes in consumer demands. The move towards advanced automation should have as its ultimate goal the unmanned factory. These are factories which do not literally run without people, but they would involve drastic reductions in labor—so drastic that they have acquired the label "unmanned."

However, automation alone is not a panacea for the manufacturing sector. We must, at the same time, improve both our management and our products. The size of inventories, particularly goods in process, must be reduced allowing us to move closer to the Japanese "just-in-time" system. Management must find ways to work more effectively with labor, whether or not labor is unionized. Management must be doing a better job of strategic planning. There must be closer cooperation between the business sectors of the corporation and the engineering and research sectors. Management must take the initiative for re-designing products and making them

responsive to consumer needs and desires. In other words, we must improve management as well as the production process.

In the end, however, our real comparative advantage is in the intellectual area. We must essentially raise the technology of manufacturing to a higher level where we do have an advantage. To do this, we must utilize all of our talents and knowledge in materials science, electronics, computers, robotics, and manufacturing. We have to recognize that we really are in a fight for our economic life and that we must do everything that we can to become competitive in all fields of manufacturing. It is not obvious that we can do this, given the strength of Japan, South Korea, and other countries around the world.

It should also be clear, however, that as soon as we are able to raise the technical level of manufacturing, that the knowledge of our techniques will again be spread around the world. We are in a situation in which we must depend on a new flow of knowledge into the process. As we make a new development and that knowledge is spread around the world, we lose our comparative advantage. We must then go into our pool of knowledge and develop new techniques again which will give us a comparative advantage. Thus, our true comparative advantage is our capacity to develop new knowledge, and we have to be concerned with how we keep that knowledge base advancing more rapidly than other places in the world.

It is clear from this process that knowledge is the source of economic power in the United States. It is our basic comparative advantage. The universities are the basic source for the creation of that knowledge, as they take the responsibility for basic research. We must also have the ability to apply that knowledge. This requirement is one of the reasons why we need closer relationships between corporations and universities.

The major factor, however, that will determine progress is the amount of funding available for research. Research is critical if we are to upgrade the processes of production and stay in the forefront of information technology. The National Science Foundation should be the major funding source for this research. Its budget should be increased significantly. The National Science Foundation should have two to three times the amount of its current budget and should be able to put a significant increment to research in information technology so that we maintain our advantage in computers. With its current budget, the foundation is performing heroically but is handicapped in terms of what it can do. The financing of research is a crucial activity for government and one that only government can perform because of the difficulty for an individual firm to capture the effects of basic research breakthroughs.

Clearly, as we said at the beginning, the economy is going through a definite restructuring. If we can make the steps toward automation and increase the funding for research, then I believe that the United States will in the end be stronger for this restructuring.

The CHAIRMAN. Dr. Cyert, the staff keeps time on us. We all have five minutes, and we try to get around to all the Members. I appreciate all of your attendance. Perhaps I will limit my question to Dr. Cyert. But before I get to the question I have a sort of preamble. I am worried about the government not using the knowledge it has about trade. Here you are talking about the use of knowledge in research, the use of knowledge in technology, the use of knowledge in business management, labor productivity, and all these other things.

When David Broder wrote the other day about the 100th Congress he said that the First Congress met 200 years ago on March the 13th, and it took until April Fool's Day to get a quorum. Maybe that is the origin of the name.

I do not know if this is true, but I do know this, that those brilliant founding fathers that Dr. Arthur Schlesinger called the greatest array of talent in the history of man—Jefferson, Madison, and Hamilton—the very first bill they passed was a tariff bill. Incidentally, that bill was referred to this Committee.

The tariff bill passed. They all regretted the loss of idea about free trade. They made the same political statements that we hear

today, that they were free traders, and they were against protection. But they took umbrage at the so-called economists who talked about comparative advantage. At the time we were all in agriculture, and merry old England was producing all of the finished products. Under comparative advantage England would be able to keep us as little more than an economic colony. Hamilton in his report on manufacturing said, the heck you say, we are not going down that road. We are going to build up the industrial backbone.

Now I am jumping to Dr. Kozmetsky, and Mr. Samuel and their cleavage in presentation, because you talk about the quality of jobs. On Page 12 of the statement Dr. Kozmetsky says the Japanese, are downplaying job quality. In other words, they are downplaying those factors that contribute to the better quality of life, like housing, transportation, retirement, Social Security. I can tell you can not downplay those things or we are not going to be Congressmen or Senators. I can tell you that. That would be over with. And as Mr. Samuel says, we want those things. We want that standard of living.

Now lets jump to the money that Dr. Kozmetsky talks about putting in manufacturing. I have seen that technology. I brought Elgin Watch from Elgin, Illinois, down to Blaney, South Carolina, and we renamed the town Elgin, South Carolina. We increased the productivity of watchmaking by 35 percent. There is no watching making in the United States of America today. They say in Arkansas Timex is assembling some parts, but really watchmaking is gone 100 percent. Black and white televisions, video cassettes recorders, 50 percent of the clothes in this room, 80 percent of the shoes. Yes, that is good. Dr. Rostow says no one can completely control industrial flows, but, I am worried about completely losing all our industries.

And let us go to the technology. With respect to textiles I have just come from the Far East, and I have seen Daewoo in Korea, and I have seen the cultural approach—Mr. Samuel, you would enjoy this—where the young ladies between 18 and 21 want to get a dowry. So they come in and they live in barracks and they work at $1.35 an hour and glady work six days a week and no overtime, and after working three years they are gone. They go back out and raise those families.

Now I am going to tell you they are all making the same thing for different name manufacturers. I will not name them, but it was amusing because there were different aisles just going for thousands of feet just producing all these name brands, and it was all coming out of the same plant.

But I went into Stone Manufacturing, Stonesware here in the U.S. The age average in Daewoo would be around 20 to 25. The age average in Stonesware is 50, so they have health costs, they have retirement, they have benefits, and pensions, and everything else. Stonesware is automated. They stamp the pocket on the shirt. They put on the strip that puts on the button. They stamp on the collar. They used to have 3,000 employees. They are down to 1,700. Do not tell them about automation. In fact, the textile industry has put in $8 billion over five years.

I have seen in contrast steel, Georgetown Steel came to Georgetown, S.C. and they have the most modern plant, but they are

having a difficult time. It is not just wages, because theirs is lower than the rest of the country. But they are not able to survive, because our friend McNamara and the World Bank runs all over and says you have got to have a steel plant, and you have got to have a steel plant, so everybody gets a 2 percent steel plant. In Brazil, Nigeria, and everywhere else, and outside my front door in Charleston they are dumping steel at less than cost. So what happens, U.S. Steel says we will buy Marathon Oil. We are not pro bono public.

I have seen the automation. I see all of this, and my question is, I am fearful that I am going to do all of these things that you are asking, competition is going to force it, and I am still going to be going out of business. I still need my government, the comparative advantage being, of course, the government. Do you not think that we need some kind of government policy in trade in addition to all of these things?

Dr. CYERT. Well, I do not favor protective legislation. I think certainly activities on the part of government to level the playing field are good. I think to get openings so that we can have a fair chance of selling our products is go. Most importantly I think we have to look at action to keep the exchange rates from getting completely out of phase.

We went to a floating exchange rate because of the great difficulty with pegged exchange rates, but we have got to have something in between. I do not believe that one can allow exchange rates to completely float because of the great difficulties that we have and great problems we cause our people when we have to make adjustments resulting from large changes in the exchange rate.

But I think to keep out other products lowers the standard of living rather than raises it, and we have to be careful about confusing competitiveness with protectionism.

The CHAIRMAN. Thank you.

Senator Danforth.

Senator DANFORTH. I am going to ask the same question, just to give the others a chance to respond also. The title of this hearing is The Competitive Challenge Facing U.S. Industry. The great word that is being used is "competitiveness." My question is, should that be the goal for the United States? Should we take the position that we as a country can still compete, that we should try to compete in international markets, and that we should pursue policies which make us more competitive? Should we attempt to deal with tax legislation, trade legislation, legislation relating to education, retraining, and so on, in an effort to attempt to make us more competitive, or instead should we take the position that really we cannot compete, our best days are behind us, we do not want to go through the same thing that we went through with agriculture in our industrial sector, and the time has just come to raise the barriers?

President Cyert said that the choice is automate, emigrate, or evaporate. Maybe there is another choice, which is, legislate. For most of our history as a country we did not depend heavily on exports. The U.S. as a world trading country is a phenomenon that has been with us for just a few decades in history. Maybe we should. I do not propose this. In fact I am stating the devil's advocate position. But should we pursue this goal of competitiveness or instead should we pursue the goal of protecting American jobs on

the theory that our industry is going to go down the tube if we do not protect American jobs? What is your answer, Mr. Samuel?

Mr. SAMUEL. Senator, let me first say that I am vigorously against protectionism. I am not sure what it means. I have to say that first before I say anything else or you will not take me seriously.

Senator DANFORTH. I am not sure I took you seriously just now.

Mr. SAMUEL. I am not sure it is an either-or question, really, that you have posed. It seems to me we can be competitive, we must be competitive in order to preserve our standard of living.

Otherwise we are going to become the largest banana republic the world has ever seen, and that is not going to be able to maintain our standard of living. But it seems to me that a wise and thoughtful approach to our trade problems has to be a part of that goal. The fact is that we are being outmaneuvered by our trading competitors. They undertake practices that we have so far not dreamed of doing.

Senator DANFORTH. Mr. Samuel, I am just going to butt in for a minute. Our trade competitors obviously pursue practices which are terrible, heinous, illegal, but the focus that I really want to put on the question is, should we attempt to correct those practices in order to compete? Should we attempt to open up other markets? Should we attempt to be more creative and productive in the United States? Or should we face up to the issue that maybe that is not the right course at all, and that the objective should not be competitiveness but instead protectionism? If it is an either-or, if it is a choice between the two, which one should we pick?

Mr. SAMUEL. I do not think it is. I do not think the question can be handled that way. As a matter of fact, I do not think it is an appropriate question for the subject before us. Just as the President's Commission, which surely was not a protectionist body, which consists of, I think, 27 business leaders and three of us in the labor movement, the business leaders mostly from the high tech area, nevertheless said that an approach to the trade problem must be part of an approach to meeting our competitiveness challenge, that no matter how competitive we may be, nc matter how many of the things that my two colleagues suggest in terms of research and development and training and education and so forth, they will fail, unless we are able to compete equally and levelly with our competitors. And it seems to me it is all part of the same package.

Senator DANFORTH. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Adams is next.

Senator ADAMS. Thank you, Mr. Chairman.

I first want to state a simplification of the example I gave at the beginning of this. I agree with Senator McCain that what we have to have is a sharing of where we are pouring money and research where others are not. They are placing it directly into their technology transfers, and directly into things that compete with us. We have seen this with the Germans. We have seen it with the Japanese.

My question is, where in the opinion of you, Dr. Kometzsky, is going to be our market? You have stated in your prepared testimony that the Japanese have a basic policy, and I agree with you, I

have been there, as the Chairman mentioned, where they are concentrating on building their technological plant and their competitiveness, and it comes from a long-time cultural experience that we must bring things in raw, apply to them labor, and export them at a profit, and that is what we live on, and therefore they are holding down their standard of living even though they may be making more money now.

If we are going to use the regulatory powers of the United States which reside in this Committee, which nations should we be targeting as our niche given the fact that we go to our competitors who are the developed nations and say you have to share our deficit problem with us because we have been carrying this deficit for your benefit, whether it is a blue water navy or whether it is a number of other things.

If we pay that from them is there another market? I think particularly of the Pacific Rim. That is my first question. The second thing is, can you tell me of a single major manufacturing program that has come out of the Department of Defense since we did the 707 and transfer technology directly to manufacturing, or where it was copied by the 747, copying the C5A?

I do not know of a government major manufacturing shift that we had used. Now, maybe out at NASA there was something, but I am concerned about where we are putting our money if we are going to make this a competitive product, and with this deficit that we have as a nation the money to do what everyone is talking about, education, the Senators, and so on.

So those are my two concerns. Would you respond to those, please?

Dr. KOZMETSKY. Yes, I thought about your question long and hard because the reason that we were able to do and the confusion between DOD and NASA goes back to the fifties and sixties. Those of us who came back from World War Two were facing a whole new economy at that time. I happen to have been amongst those in California, and we thought the cold war would end in five years. None of us could act, and none of us wanted to go into orange groves. We did nothing with all the defense work we did out there other than looking at commercializing that defense.

1967, 1968, our study said something happened in this country. That stopped. Now, part of the thing we are saying, it can be done. Today if you took the very large-scale integrated circuits and all of the software and computerization that we have been doing we can finance things still by DOD, the domestic market is only 15 percent. Now it is an emerging, growing market. I can see a lot coming of it. When I look at lasers, low-powered lasers today, I find that the leading production of laser tubes is in Israel.

All right, so it says we have not been focusing on getting these things moved into what I call the commercialization process.

Senator ADAMS. Are we going to sell these in the United States or are we going to sell these abroad, because Japan has a very definite migration policy of Nissan comes in and after they arrive at a certain percentage then Honda is in the market, and after Honda arrives at a position, then Isuzu comes in, and so everybody then penetrates a market. My question was, who else around the world is buying, or do we have to concentrate on whom?

Dr. KOZMETSKY. Well, we find markets which I think are going to pop up which people do not talk about today. India has done a tremendous job. That market is getting ready. You would be surprised at the per capita income that that market is now gaining. There are other spots in the world certainly that we ought to be doing more and aiming toward them. But in the short term, as the title of my paper says, let us be realistic, and that is what you are saying, Mr. Adams. I am theoretically and in principle against protectionism. When I combine theory and principle I go back to David Hume, who is a colleague and older than Adam Smith, who warned of two things: This was going to be happening, and what you must then do is realize there are comparative advantages and you ought to be a gentleman about how you do it or you are going to get the worst of protectionism, which is war.

That is what I meant by not only must our goal be to compete, but it must be to cooperate.

I think we ought to think of building a domestic market. I indicated you are going to have different concentration problems in our industries than in the past. How many foreigners versus domestic do you want? I do not know of anyone working on that theoretically.

The only place I know and the reason I suggest it to this committee, you have got to look at the reality. You have got to take action now. And we ought to be examining more of these in detail.

Senator ADAMS. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator McCain.

Senator MCCAIN. Thank you, Mr. Chairman. I want to thank the witnesses for some very important information they provided us with and I appreciate the comments of my colleague from the State of Washington on this issue of burden-sharing, and I think we will be working on that for a long time to come—I hope as soon as possible.

Dr. Cyert, you mentioned the "automate, emigrate, or evaporate" situation. And I think, as any slogan, it is probably largely accurate, except that I think we found, at least to some degree, a middle ground and that is in the concept of the Mequiladoras, where we have moved our industries across the border where the labor-intensive part of the job is done, as you are aware, and the nonlabor-intensive parts of the process are completed on the U.S. side of the border.

Also, those monies that are paid to Mexican citizens are spent on our side of the border. Also, those corporations which were planning on leaving the United States at least give us some benefit. I know of no company that, if they could not locate in Mexico, would not be going to Taiwan or Korea or Singapore or somewhere else.

I would appreciate your comments on how you view the viability of that process as a way of breaking out of the equation that you described.

Mr. Samuel, I appreciate your service on the Commission. I think you provided us with a blueprint, as I mentioned in my opening remarks, for some of the actions that need to be taken. Certainly it is not a panacea, but I think it was a much needed input into the

process. I think most of us would agree that the JTPA is an improvement over the previous CETA programs.

I also have encountered major difficulties, as I know you have, with the JTPA, primarily in the area of child care, traveling from where the industry has disappeared to where the jobs are created and many other areas. And I would appreciate your comments on how we can improve.

I believe we are going to see legislation for job training in this Congress, and I would like to hear your comments on that.

Dr. Kozmetsky, I know you, being from Texas. Many of us noted with glee the inception of the MCC which you are very familiar with, and I would like to know whether the impact of the departure of Admiral Inman and other corporations is going to have an impact not only on MCC, but the viability of this entire concept and what was created as possibly a way out of this technology lag that this country has. This doesn't seem to have borne fruition to the degree that we had anticipated at the time of its inception.

So I would appreciate an answer to those questions.

Dr. CYERT. Let me answer your first point. The answer is, I think the process you described is a very interesting form of adaptation of the economy. It is a compromise between more automation and getting completely out of the country.

I think we have seen many adaptations of this kind. Your example also points out, I think, in a nice way a point that I was trying to make about automation. That is, using this form of adaptation, you save some employment in the United States that would otherwise have been lost.

And so I think forums like that are good. I still prefer to see more emphasis on capital investment because I think in the long run that will make us more competitive throughout the world.

Mr. SAMUEL. Senator, if I could add a word on the other side of that issue and then go on to the point that you asked me specifically. Our feelings are not so optimistic about the twin plant program.

I wish we had some evidence. I wish you or someone else could give us evidence that any company that has gone down there would instead have gone to Taiwan or Korea if it had not gone to Mexico.

Senator MCCAIN. I would be more than happy to provide you with reams of that information.

Mr. SAMUEL. We have not yet detected any company which has said that.

We feel that this, as simply a means of exporting jobs, is not going to help our competitiveness. We need those jobs. There are millions of workers in this country in the textile and apparel areas, as the Chairman knows, who are not highly skilled who need jobs of that kind. And that is one of the areas where they are losing them.

I don't think we can survive as a country without any assembly jobs. And if we continue with our present work, that is exactly what is going to happen.

As far as JTPA is concerned, I think you are correct. JTPA has not really met the needs of the displaced worker. Title III which deals with this as part of JTPA was an afterthought There are not adequate guidelines or goals in the legislation. It has been under-

funded, and as a result we have to do much better. We have to get workers who have been displaced back into the labor force as quickly as possible, not only for humanitarian reasons but for economic reasons as well. Unemployed workers are very costly to this country.

I hope that the Department of Labor Task Force Report will get a speedy and favorable consideration by the Congress and would meet the need that has not been met by JTPA so far.

The CHAIRMAN. Thank you.

Senator Gore.

Senator GORE. Thank you, Mr. Chairman. I would like to also welcome this distinguished panel of witnesses. I have worked with at least two of them in the past and certainly enjoy having this opportunity to talk with them again.

I would like to put into the record, Mr. Chairman, a document which was brought to my attention, prepared by the Tokyo Office of the U.S. National Science Foundation, entitled "Japan's Key Technology Center Selects 25 R&D Projects for Capital Investment."

I don't know if our witnesses are familiar with this, but maybe in rough outline they are. The projects included for funding have a far more commercial tone than the projects we would fund with our comparable programs.

Probably the most illustrative example is this project: Development of information systems for wholesaler dealer complexes. That is not a basic research project of the kind that NSF quite properly concentrates on.

What can the NSF do? What can other agencies of our government involved in providing funding do to look more in the direction—not abandoning the basic research—but to give an adequate amount of attention and resources to the kinds of projects that enable us to bring new knowledge into commercial application so we can bring it to bear as a resource in this international competitiveness battle?

Dr. CYERT. Let me answer that. First, I think there are some things NSF is doing that are good. For instance, with the engineering research centers Carnegie-Mellon has one in design and we are obligated to meet with firms and discuss the latest developments and stimulate technology transfer.

We have to make an effort as part of that center to get industrial affiliates who will really participate in research projects. There is a great emphasis on the transfer of technology and the transfer of knowledge. I think that is a good one for increasing competitiveness in American industry

But there is a proposal that I would like to have you to think about. I believe that universities can function in the United States somewhat in the way that MITI does in Japan; only this would be the American way, and it would be somewhat more decentralized.

Research universities all have certain fields in which they have a greater knowledge than other universities. For example, at Carnegie-Mellon we have maintained strength in magnetics, the only major research university to do so.

Well, we formed a consortium, when we discovered that the Japanese were targeting the magnetic recording industry and that

there had been very little research in that industry. We organized a consortium of firms from the industry.

We have 10 firms, each of which agrees to put in $250,000 a year for three years. They get a voice in the research program. We have conferences, and they get papers. If there are any patents, we take the patents out and they get royalty-free licenses.

We have an arrangement whereby the research will get done. Some of it will be basic research, some of it will be more applied. The firms are there to take the results, and then go away and compete.

The problem is that the funds that are put in should be more highly leveraged. I would like to see a new program which would require new funds for NSF. When a consortium of this kind could be put together, the university would submit a proposal to NSF and the proposal would undergo peer review.

Those that were approved would result in funds going to the university, so that it could leverage the industry contribution. We would have a situation that would be an American version of MITI. MITI puts together consortium and the government puts in funds to leverage the private contribution.

I think this kind of program on a large scale could do a great deal to increase technology transfer, but it does require additional funding.

Dr. KOZMETSKY. I would like to piggyback on that, if I may, Senator Gore.

The CHAIRMAN. Go right ahead, and then I have Pete.

Dr. KOZMETSKY. I think you have to add one more thing, and that is the technology transfer that my colleague has just talked about. I also want to know right at the start, where are the manufacturing bottlenecks that we should be researching on, so that when it is transferred we have also licked the manufacturing bugs, and that is in my recommendation.

The CHAIRMAN. Senator Wilson.

Senator WILSON. Thank you, Mr. Chairman.

To pick up on Dr. Cyert's very evocative and catchy phrase, posing the options as many see them, automate, emigrate, or evaporate, you have said, I think, doctor, that you think in leveling the playing field, not in protectionism, and I think there is a valid distinction between the kind of conditional retaliation for a specific purpose and a specific time to knock down tariff or non-tariff barriers. So perhaps we could add retaliate.

But I think overall, as we look at a number of things, maybe a new verb should be "equate" as in the sense of making equal or leveling the playing field.

It seems to me there are a variety of things to ask ourselves. There are certain things that I think are self-inflicted wounds in terms of our competitiveness and other things that indeed do call for a strong governmental role to deal with the unfair trading practices of foreign governments, where we are seeing not a fight between foreign private sector and domestic, but really the kind of thing that we have seen in terms of subsidized competition.

I can think of a number of things, and they have been touched on here. The question from Senator McCain really had to do with the kind of breakthrough that we are hoping to achieve with MCC

and the legislation that permitted joint ventures in R&D as a relaxation of our antitrust principles.

Now, there's a question there, because a number of sophisticated businessmen that I know are shocked to learn the Japanese have almost identical antitrust laws, that they are a legacy from General MacArthur. And they are shocked because, of course, the Japanese have dealt with that in the simple way of not enforcing them.

Should we be relaxing ours or is there some mechanism whereby we can compel our competitors to enforce theirs, so we level the playing field in that respect?

And there is one area which of course is particularly painful to me because my state, which is particularly export-dependent, is being ripped off, whether we are talking about producers of computer software, those that produce chemical formula, those who produce video cassettes.

Senator Gore's state is home to a thriving music industry. They are being ripped off at a fearful rate, perhaps more than any other single sector of that copyright community. The recording industry is perhaps the chief victim.

So we need to do something. This is not self-inflicted, except insofar as we have not been vigorous enough in compelling our trading partners, particularly some to whom we give amazingly preferential treatment, to refrain from this invasion of intellectual property rights, that and something as simple as the kind of dumping that a number of Japanese manufacturers of semiconductor chips were guilty of last year, and for decades in fact.

These kinds of things it seems to me involve a role for government that is not protectionist, but that is valid and in fact very late in coming. This is my Administration. I worked hard to elect them and re-elect them. But it seems to me that they have been brought grudgingly away from preaching platitudes about free trade into a time when we are in fact doing something about trying to level that playing field.

I am asking a series of questions, and one was addressed by Senator Gore just now, and your response that perhaps the way for us to compete with MITI and that collaboration between the public and private sector, between government and the private sector in Japan, and their virtual cartelization is by a joint venture between universities and the private sector here on R&D.

One thing overall—I think all these require attention, as do whether or not our tax structure encourages investment, savings, and modernization, which I do not think it does, and neither does the Young report.

The one thing that I find most challenging, because all those things seem to me to be remediable, but by God, as a life-long defender of the free enterprise system and the American version of it, I am truly challenged to suggest to you how we are going to supply the long-range planning that in fact the Japanese do when our managers seem compelled by their shareholders to be obsessed with quarterly earnings statements that prohibit the long view.

And maybe you can give us a basic view there, because I think that is perhaps the greatest threat to our competitiveness.

Dr. CYERT. Well, in terms of the antitrust laws, no, I do not think the antitrust laws should be relaxed. I think we have to rely funda-

mentally on the fact that we do want a competitive society and a competitive world, and that it is under that kind of a system that we will prosper.

I think there is too much evidence that when individuals are protected, when firms are protected, that we do not get the greatest potential realized from those individuals or organization. So fundamentally, I believe in a competitive society and a competitive economic system.

The points that you raise about government intervening to try to help level this playing field I applaud. We have got to move in all sorts of directions to try to make the world competitive.

However, we do not want our firms using any of these conditions as excuses. They have to face up to the fact that the world is not fair, that our society is not fair.

We want firms and people that can overcome obstacles and can compete effectively. Do not misunderstand me. I think we want every effort made to make the world fair, but we also want managers who, regardless of the conditions, are going to win.

This part is important and one that should be a fundamental premise of our activities in this country.

Incidentally, I think that this committee should consider ways to increase, savings and investment. The possibility of changing the tax system to discourage consumer expenditure and increase savings and investment is something that we have got to do for the long run. An expenditures tax should certainly be considered.

In terms of management, there is increasing sensitivity on managers to be thinking long run. I know that all of the forces are there to push on the short run, just as they are for you and even more so for Representatives.

Yet you know yourself that Senators and Congressmen are thinking of the long run, even though by some logic they should not. They should worry only about the next time that they have to be elected. But we do have people in this country who are worried about the long run future of our society, and we do get more long run thinking than might be indicated.

My hope is that we can increase the number of arrangements of the kind I have discussed, the university functioning as a MITI, changing the tax system to encourage less consumption and more investment, so that for the long run we will, without trying to plan every unit of our activity, be able to compete effectively.

The CHAIRMAN. Very good. All of our distinguished witnesses have other engagements and the hour is getting late. I am going to yield my time to follow-up questions.

Senator McCain.

Senator MCCAIN. Thank you, Mr. Chairman.

Mr. Samuel, I would appreciate it if, maybe for the record, you could respond a little more as to what changes in new legislation you would like to see over the present JTPA legislation that would make it more effective in addressing the displaced workers situation.

Dr. Kozmetsky, did you want to answer the question that I had?

Dr. KOZMETSKY. The question asked is what is my personal opinion of what is happening with MCC as a collaborative method of

doing advanced research and what is the impact of the Admiral's leaving and several companies departing from the consortium.

I think first it is important to say that I think Admiral Inman has already put in place—there are about 550 to 600 scientists and engineers involved with MCC. They beat their original record of laying out about 24 major programs which would keep this industry competitive.

You have got to remember, they would not start any program that could be found in any laboratory in any one of the companies. So these are way ahead of the companies.

The staff has been put in place and research has come faster than they had anticipated. Next, the morale of the people since Admiral Inman has left is extremely high while they are looking for the next executive.

About the companies that left. There was a merger and one of the partners to the merger originally did not want to attend as part of MCC, so that one was lost. And I do not know how to comment on the other two; dollarwise, extremely insignificant, and I won't bore you with the details.

Then let me just leave you—and the work we do is always addressing problems we do not have answers to. We cannot find any university, any Federal lab, any corporation that organized itself for technology transfer. The thing then is to watch, to see if MCC says, if you have got 20-odd companies all getting the same research and one beats the other significantly into the marketplace, what will the others do? And that is where we are.

Senator McCain. Thank you.

Thank you, Mr. Chairman.

The Chairman. Thank you.

Senator Gore.

Senator Gore. I will be very brief, Mr. Chairman. I would like to give brief responses to three questions, though. First, following my colleague from California, do you believe we need greater efforts to develop an international treaty on the protection of intellectual property rights?

Dr. Cyert. I would strongly favor that action. The current system is ineffective.

Mr. Samuel. I agree.

Senator Gore. Secondly, do you believe that the current restrictions on some of our current national laboratories requiring them to focus 80 to 90 percent of their work on the mission assigned them by that laboratory should be relaxed if in the process of their work they uncover and develop a project that has enormous potential for application in areas outside of their charter, strictly interpreted?

This is the so-called "work for others" program which you may be familiar with. My own view is it should be expanded, and I am interested if you agree from your perspectives.

Dr. Kozmetsky. I have certainly been following what has been happening in the great state of Tennessee with Oak Ridge, and it is another success story, how quickly within a year that program has been expanded once the private sector got working with that whole area.

More of that should be done, and I think we should be aiming at larger programs.

Senator GORE. Now, third, let me describe for you an idea and ask you to assess its potential. You spoke, Dr. Cyert, of the possibility of universities functioning as a kind of a MITI in miniature. And you, Dr. Kozmetsky, talked about the pre-eminent importance of our computer technology in preserving the competitive advantages we still have.

Super-computers magnify that capacity. If you have universities with super-computers and each university with a super-computer establishes a family of companies or working groups that are pursuing particular ideas or lines of work, it just stands to reason that their ability to be productive and to develop those ideas would be enhanced if they had the ability not only to communicate with their counterpart teams clustered around other universities and research institutions, but also to link up their super-computers where they are time sharing work on the same sorts of projects.

Yet the current fiber optics network in most cases—if I could have the indulgence of the chairman to proceed just briefly on this—in most cases the communications links are capable of transmitting only around 50,000 bits per second. A fiber optic network capable of, designed for this purpose could transmit a billion bits per second or a gigabit. The Japanese are working on one an order of magnitude larger.

We in the Congress stimulated commerce as conventionally defined with the passage of the interstate highway network. On the anniversary, the thirtieth anniversary of that system, I introduced a Super-Computer Network Study Act, incorporated by this committee into legislation last year.

Might it be a smart thing for the country to stimulate with government participation the creation of a fiber optics network linking super-computers in this country and encouraging the use of that network by these spinoff enterprises, all information-based, of the kind that you all talked about in your earlier testimony?

Dr. CYERT. There is no question, I think that is a creative idea. Again, it is the kind of idea that can help make our economy more competitive through the use of our brain power, which is the key, as I have tried to emphasize.

I think that kind of a bill, that kind of an effort, is really what you mean by saying we are now in the information age. We have to look for ways of linking sources of information in the country.

I think it is an important idea. We have at my university with IBM created the first and the largest scale network in the country. We have the capacity for 10,000 computers to be linked together, the most advanced work stations.

We are going to increase the productivity of students with this network and the kind of software we're developing. We should be thinking this way for the whole country and thinking of networks for the whole country.

Mr. SAMUEL. Could I just make a quick comment, Senator? I am all in favor of it. I just hope the fiber optic materials are made in the United States.

Dr. KOZMETSKY. If you want to grab the lead in manufacturing and regain it and leapfrog, you absolutely must put this in, and it

has got to go beyond government laboratories and universities. It has got to become available to our medium-sized companies as fast as we can do it.

Senator GORE. With interchanges along the way.

Thank you, Mr. Chairman.

The CHAIRMAN. Very good.

Senator Wilson.

Senator WILSON. Thank you, Mr. Chairman.

One final question, really pursuing the earlier question that I asked to Dr. Cyert, and I would ask anyone on the panel who wishes to respond.

You made the response I anticipated when I asked about the antitrust provisions, and I do not blame you and I am inclined to make the same response myself. On the other hand, if we look to universities who are doing research, even if it be basic manufacturing technology research in conjunction with the American private sector, can we really delude ourselves that we are doing the same kind of thing that MITI is doing with the Japanese competitor.

Because we are not talking about a university having the ability to provide long-term capitalization or credit of any kind. We are not talking about their ability to create a monopoly. We are in short, I think, having to face the reality that MITI and a number of other foreign governments are engaged in what is a virtual public-private partnership that amounts to a cartel, with tremendous funding and tremendous marketing strategies built into targeting, as the Japanese have the home electronics industry in this country.

Now, I do not really want to see us abandon our own internal competition, and yet it seems to me that we have been the victims of a very shrewd analysis on the part of our trading partners. They have decided how they can successfully target our markets and capture them.

And they were fast on the way to doing it with one of the drivers of high technology when finally we were—the issue is not yet decided, but we at least have made progress in terms of a formal agreement with the Japanese on semiconductor chips.

But I think that we have not really come to grips with that basic distinction in the way we operate and with the tremendous advantage it gives them. I do not really like their model, but I think we had better devise a means of dealing with it, and I do not think we have.

If you think that we have, if you can think of some way that we might do so, that would be of intense interest to me.

Mr. SAMUEL. If I could make just one comment, Senator. I think much of what you have said bears very thoughtful consideration and I think has a lot of merit. When our antitrust laws were written in the last part of the last century and the early part of this century, we had very little to fear from foreign competition.

That is no longer the case. And it seems to me if you look at the antitrust laws now, revisit them, as the expression goes, we should do so in the light of our current competitive situation.

Mr. KOZMETSKY. My response is we are playing on an uneven playing field, and you have got to face that reality. There are a number of things you said that already says that must be done.

Furthermore, I go some distance with my colleague, Dr. Cyert, but I tend more to agree with you. It takes more than a university putting a MITI together. I think the universities have an important role to play. But we've got to put together a plan, and we are going to do it the American way, which is more of a political process than an economic process.

We have got to have some agreements. You have got to bring the people into play, because one of our cultural and value systems is if you do not put a nickel into it it is not worth anything and you are not going to adopt it. So people have to put up some money to do this.

We have got to have it out clear. What you are really doing with that type of a program you are suggesting, Mr. Senator, you are beginning to do two things. You are changing the environment in this country, and if you have picked them right you have begun to give hope in terms of a dream and you have changed the attitude of the American public.

And those are the two most critical things we need.

Dr. CYERT. Senator, one of the implicit assumptions in the discussion of this issue is that we are betting in this country that a decentralized system will beat a centralized one in the long run.

There is a lot of evidence that decentralization is the system that is most consistent with democracy and with a free-enterprise economy.

I do not really worry in the long run about cartels. Cartels, as we have seen in OPEC, have the seeds of their own destruction within them. There is a fundamental problem in any cartel that restricts its life. Remember, we have had cartels in this country, too, and they have, even without antitrust legislation, generally fallen apart.

So I think we cannot allow ourselves to be stampeded away from our fundamental values, even if in the short run it looks as though another country with a different kind of system has an advantage. We have to continue to analyze and find the means to do it our way.

I would like to again emphasize that our long run hope is our brain power. We will be competitive if we can maximize our ability to use that brain power.

The CHAIRMAN. I do not just want this to be simply a hearing. I would like to continue working with each of the three of you. You have made an outstanding contribution to our kickoff in this particular concern, and we are very, very grateful to you. Thank you very much.

The hearing is adjourned subject to the call of the Chair.

[Whereupon, at 12:30 p.m., the committee was adjourned.]

SCIENCE, TECHNOLOGY, AND U.S. INDUSTRIAL COMPETITIVENESS

TUESDAY, FEBRUARY 24, 1987

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The committee met, pursuant to notice, at 9:35 a.m., in room SR-253, Russell Senate Office Building, the Hon. Ernest F. Hollings (chairman of the committee) presiding.

OPENING STATEMENT BY THE CHAIRMAN

The CHAIRMAN. The committee will please come to order.

Mr. Secretary, we welcome you to the committee.

I have a statement for the record.

This morning the Committee on Commerce, Science, and Transportation holds its second Full Committee hearing of the year on U.S. industrial competitiveness. The first, in January, examined the overall competitive challenge facing this country and some of the fundamental steps we as a nation must take in order to respond to that challenge.

The hearing today focuses on what federal policies, and federal science and technology policies in particular, can do to help this country's economic competitiveness. As the President's Commission on Industrial Competitiveness concluded in its 1985 report, technology is America's strongest competitive advantage. Technology alone cannot solve our economic problems, but we will never solve those problems if we allow ourselves to fall behind in the race for technological leadership.

This mornining we have two distinguished witnessesses to discuss these matters—Secretary of Commerce Malcolm Baldrige and National Science Foundation Director Erich Bloch. Both of these gentlemen came to government after successful careers in business. Both now administer important science and technology programs. The Commerce Department has several technology programs, including the National Bureau of Standards. Mr. Bloch's National Science Foundation supports basic university research across the full spectrum of science and engineering disciplines.

I hope that we can examine two related issues today. First, I want to review the administration's competitiveness program, including those parts dealing with civilian science and technology. The President has recently transmitted a package of competitiveness proposals to Congress, and his fiscal year 1988 budget request contains several important funding decisions. These proposals cover

a wide range of subjects—science and technology centers, trade policy, antitrust, regulatory policy, and education and training. The Committee needs to hear more about these various proposals, and examine what they would and would not accomplish.

Second, and related, I want specifically to examine current federal priorities for civilian science and technology and their relationship to economic needs. The administration's program focuses on increased funding for basic scientific research, including, we now hear, not only increased monies for the Science Foundation but also a Presidential decision to allow the Energy Department to build a $4.5 billion "atom-smasher," the Superconducting Super Collider. I favor support for pure science, but science per se is not this country's weak points; our scientists continue to win more Nobel Prizes than anyone esle.

I am more concerned about basic technological research—fundamental research to understand and create new processes and devices, especially for manufacturing. The United States seriously behind Japan in manufacturing, not only in the application of what has already been invented but also increasingly in new basic technology itself. Japanese advance in basic processes for manufacturing semiconductors is an important example.

It will not do our country a great deal of good to make great scientific discoveries if, in the final analysis, the Japanese are better and faster at using advanced product and manufacturing technologies to turn those discoveries into successful commercial products.

Both Secretary Baldrige and Mr. Bloch have tried to address this problem. The Commerce Department's little-known National Bureau of Standards specializes in fundamental research to develop the scientific understanding and basic technological tools industry needs to improve quality control, to make the factory automation work, and to produce new products in fields such as biotechnology and fiber optics. At the National Science Foundation, Mr. Bloch has created new engineering research centers and supercomputer centers to upgrade basic engineering research.

I am concerned, however, that even with these programs the federal government's civilian science and technology priorities are skewed. Total basic research on manufacturing by civilian agencies totals less than $50 million annually, but the President now proposes to spend billions on an atom-smasher which holds great scientific interest but promises almost no practical value at all. In the current economic and budgetary climate, is his the best course?

I hope that the Committee can explore these and other questions with our witnesses. Because Secretary Baldrige must leave before the hearing is over, we will hear from him first. Then we will hear from Mr. Bloch. We welcome them both.

Mr. Secretary, we would be pleased to hear from you now.

If you would like to include your statement in its entirety, it will be so included, and you can summarize it as you wish.

STATEMENT OF HON. MALCOLM BALDRIGE, SECRETARY, DEPARTMENT OF COMMERCE, ACCOMPANIED BY DR. ERNEST AMBLER, DIRECTOR, NATIONAL BUREAU OF STANDARDS

Secretary BALDRIGE. Thank you, Mr. Chairman. I would like to do that.

I would like to begin in reviewing the President's competitive initiative, and summarize then what the Commerce Department is doing.

The President has established the goal of assuring American competitive preeminence into the 21st Century with a program that includes increasing investment in human and intellectual capital.

We clearly have to upgrade our education in today's competitive world.

Second, promoting the development of science and technology. That of course is what leads to increased productivity that makes us competitive.

Third, better protecting intellectual property. We have been at a great disadvantage in a great many countries abroad until very recently, Mr. Chairman, on what I would call just being ripped off on intellectual property.

The estimates can run as high as $10 billion to $15 billion a year on that. That is, we have been able to get a lot of the countries involved, on the right course in setting up their own laws. But we still have some tightening up of our laws to do, also.

Fourth, part of this program is enacting essential legal and regulatory reforms. We think there are some legal bars in the way of increased competitiveness, barriers that should be removed.

Fifth, shaping the international economic environment. It's impossible for anyone country to pull the whole world along with it. We live in a global economy now. It does make a difference what our partners abroad are doing in their economy, as well as ours makes a difference to them.

And finally, eliminating the budget deficit. We're not going to get that trade deficit down until we get the budget deficit started down on a solidly descending path.

This is really a government partnership with our private sector to raise U.S. competitiveness in the international marketplace. We're under no illusion that further government involvement in the private sector is a panacea for improving competitiveness.

As a matter of fact, a lot of our proposals are based on the need to further reduce government's roles in private sector affairs. But essentially, it's a partnership we're seeking.

There was a time recently, in the sixties and seventies, when the U.S. was in the driver's seat when it came to competing around the world. We had better designed and engineered goods than our trading partners.

We didn't have to battle really all that hard to win a large share of our own market in the global marketplace; the period after World War II until the mid-to-late seventies.

Other nations really didn't have any choice but to put all their skills and resources to work in order to export more, while we were having it comparatively easy because of our lead after World War

II, other countries were being forced to learn how to export in an increasingly tough international marketplace, learning how to compete, because they had no other choice. They had to export or die.

Today the tables are turned. It's American businesses that need to do some catching up. We have gotten behind in some areas, and we've gotten behind in some quality areas as well as cost.

But we are meeting that competitive challenge now. I'm tremendously impressed with a number of companies, both large and small, that are taking the necessary steps—and sometimes they're very painful steps—to improve their competitive position.

American businesses are cutting their overheads and other costs. They are increasing their investment in research and development, and they're increasing the quality of their products and services.

The business community is shouldering its share of the burden, and we in the government are shouldering ours.

In particular, the Commerce Department has been charged by the President with a number of key responsibilities in competitive initiatives, including the following:

Improving export controls. The Cabinet has been charged with reviewing the export control program, and by early March, we'll provide to the President recommendations to eliminate undue burdens imposed the program on American firms.

Our legislative package includes specific proposals that will reduce the burden on U.S. firms and strengthen enforcement authority.

I'm convinced we can increase our export competitiveness without sacrificing our national security objectives.

The President has called for decontrol of technologies that offer no serious threat to U.S. security; a reduction of the time required to get a license by at least a third; eliminating unilateral controls where widespread foreign availability exists.

Those are practical goals that we can meet, Mr. Chairman. Antitrust reform. The President has again called for changes in our antitrust laws that will recognize the realities of the global marketplace that we compete in.

A key to those changes will be amending Clayton 7 to distinguish between procompetitive mergers and those that create a significant probability of increased prices to consumers.

Our foreign competitors can merge to meet foreign competition, but we can't.

Export trading companies. This program has had a good start, considering what's happened to the dollar back when it was first instituted. The rise of the dollar made it very difficult to make out for those beginning this program.

Now that exchange rates have shifted, the time has come to make the law work. There are already some 300 companies that have signed up for some form of an export trading company, which I consider very good under the situation that's existed up to now.

Now it's time to make some amendments to the Export Trading Companies Act to eliminate regulatory and administrative impediments to bank participation in the ETC program.

We're not seeing enough banks in it to date. And also to clarify antitrust standards for export trading companies.

The Foreign Corrupt Practices Act. The President has established the goal of reforming the Foreign Corrupt Practices Act to remove ambiguities that have prompted some firms to abandon international markets. And that is a real problem.

With greater clarity in the law, we can continue to prohibit bribery as a means of making foreign sales, but we can avoid the anticompetitive effects of the current law. Phrases such as "have reason to know" that people just can't figure out what it means.

And also the accounting provisions. I've seen—I know two companies that I served with before I came down here whose accounting costs went up 30 percent the year after this bill was passed. People are just afraid. They don't know what to do. So they overreact.

Product liability if another area. Product liability I know is of particular interest to you, Mr. Chairman. Product liability insurance has become a significant burden on our competitiveness of the United States business right here in our own market.

And current tort law also serves as a disincentive to research and innovation that's essential to remaining or becoming competitive in the international market.

This was voted problem number one to small business by the White House Conference on Small Business last fall. That's how seriously they regard it.

Intellectual property protection. The President has included, in his competitiveness initiative, a comprehensive set of proposals that will safeguard our ideas and technology from international piracy by strengthening our laws in this whole area. We have several suggestions there.

And promoting the development of science and technology. The Commerce Department promotes the R&D initiatives in the President's program through our work in the National Bureau of Standard's laboratories and in the National Oceanic and Atmospheric Administration.

All Federal labs will encourage the commercialization of patents and research.

The President will expand our strong budgetary support for basic research, which has grown in real terms by 47 percent since 1981.

Improving U.S. trade laws. We're working closely with the USTR in our efforts to reduce trade barriers and create fair opportunities abroad for American business. We'll seek amendments to the antidumping and countervailing duty laws that we administer to prevent evasion of duties and to provide a predictable pricing remedy to cover products from nonmarket economies.

And finally, in working toward these objectives, my colleagues and I are committed to working closely with each of you. The stakes are too high for us not to make this a bipartisan national objective.

Thank you very much, Mr. Chairman. That concludes the summary of my remarks.

The CHAIRMAN. Well, I thank you, Mr. Secretary.

Why is it, for example, that this long presidential document on competitiveness from the administration doesn't even mention the Bureau of Standards? You mentioned it, obviously; it's in your department.

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One of the big hurdles is to commercialize the technology. We have heard that point from witness after witness. And here the administration goes on about product liability. That's an affair of the states. And all of the states react to this proposal, and they will continue to react.

I can tell you in my state that it's no deterrent. I'm getting industry in on the basis of our existing law. And we like it. And we don't want to have the California law, and we don't want to have the New Jersey law.

Why is it that the administration won't just say let's develop a Bureau of Technology rather than just the Bureau of Standards or Office of Technology or something? Put some money in it, so we can transmit much of the scientific development to industry in order to expedite manufacturing in this country.

It's robotics I'm getting at, Mr. Secretary. We have it now in that Navy RAMP program. Why not put it into civilian research? And other things. I can give you several examples.

Secretary BALDRIGE. Well, I think the reason that NBS wasn't mentioned was because they've been doing that job for decades. That's the one part of the government that's been intimately involved for a long, long time in helping industry become more competitive.

I think another reason is that we have been successful in the budget initiatives at the National Bureau to take on the research and development kinds of projects that we wanted to. I don't mean that we got everyone of them, but we've been pretty successful in getting monies from the Congress, and getting administration backing for them in areas like advanced ceramics research.

A particularly good one, Mr. Chairman, is the automated manufacturing area, where the Bureau, along with private industry, for several years now has been working on the very large problem of how computers talk to each other in a flexible manufacturing system; that is, how do different robots, different machine tools, with different computer programs, how do you get them all on one program?

That's at the heart of the problem of automation. The National Bureau of Standards has been doing that for several years.

So I don't think that we've short-suited them; perhaps in a couple of areas. But in the major areas we've been fortunate in getting those programs through. And they directly affect competitiveness in U.S. manufacturing.

The CHAIRMAN. What is the increase asked for this year for the Bureau of Standards?

Secretary BALDRIGE. Dr. Ambler, who is the Chairman, or the head of the Bureau of Standards, is right here. I would prefer to have him answer that question.

The CHAIRMAN. Yes.

Dr. AMBLER. The request for appropriation for fiscal year 1988 is $138.6 million, and that is over a 1987 appropriation of $122 million. That is about a 14 percent increase for the National Bureau of Standards.

The CHAIRMAN. And what would occur with that increase, if it were granted?

Dr. AMBLER. Well, the areas that the Secretary was referring to that we call the areas of emerging technology such as ceramics and automation have been funded, but we shall continue to build in those areas. For example, in composite materials which we will be starting a program there.

There will be an increase in fiber optics. That is in addition to the increase that was granted by Congress last year in bioengineering, and programs such as that.

The CHAIRMAN. So you have a lot of opportunities there, have you not?

Dr. AMBLER. Yes, sir.

The CHAIRMAN. All right.

Let me ask you, Mr. Secretary, you talked about strengthening the enforcement of trade rules. For example, we know now in our little Office of Textiles that you have an authorization for 49 slots and we have only got 35 filled. Quotas have increased. We have got over 1300 quotas. You have over 69 negotiations going on, whereas you only had 15 back in 1980. How can three people in the office carry on all those negotiations? How can you get this enforcement if you do not fill the slots and increase the personnel so that it can be handled?

Secretary BALDRIGE. Well if we are not handling it, we obviously will. But it looks right now as if we will be able to. We have had real increases over the past years. It has not just been in 1986. We have had several jumps in the calls that we have made almost every year since we came here in 1981.

If we cannot handle it, in a timely fashion I will assure you we will get the people to do it; but right now, we do not see that as a major problem.

The CHAIRMAN. Thank you

Senator Danforth.

Senator DANFORTH. Mr. Chairman, thank you very much.

Mr. Secretary, the Administration has sent us some legislation dealing with competitiveness. Obviously this is the big issue in Congress this year. And yet, putting matters in perspective, it is important to realize, is it not, that the Government does not necessarily have the key to a modern competitive country; that the country itself has to function well?

Last week I believe twice the Capital itself was without telephone service. Right now there are areas in the District of Columbia—I happen to live in one—where power has not been restored after something like 28 hours. This is the kind of thing that we associate with other capital cities—Beirut, Phnom Penh.

But these are things that the Government cannot fix. Is that not right? I mean, when we really look to competitiveness in a modern, vital country, in the end there is no statute that is going to fix the country. In the end, it has to be a country which in its private sector is tough, and mean, and lean, and aggressive. Is that a fair statement?

Secretary BALDRIGE. Well, yes, it is, Senator. But I think in looking at competitiveness, which is a word that has been used and misused in some cases so greatly in the last few months, I think it is important to separate what the Government can do and what the private sector can do.

In line with your question, I would say that it is up to the Government to work toward increasing the quality, or getting the highest quality of human resources we can as the job fillers of the future. We are falling behind in education not so much at the college level, but at the high school level. That is where a lot of those young people come out and enter the work force, and the industry has to spend a disproportionate amount of time not only training them for their job, but training them to write and read English.

So we have a problem there of increasing the quality of our human resources in order to compete worldwide and increase our productivity. And those are mostly I would say State Governments, but the Federal Government certainly has a role.

Second, we have to maintain as a Government as has the country as a whole our technological leadership. If we let that slip for example through not enforcing our own trade laws vigorously enough, or allowing other countries to keep their economies closed so that they can nurture high tech industries without our being able to participate, we will be sorry in 5, 10, 15, 20 years. We will gradually lose the technological lead.

Third, the Government has to be able to provide a sound macro economic and regulatory environment. That is the Government's job. Obviously if we are going backwards in the economy it is very hard to become more productive.

Senator DANFORTH. Can I just interrupt you at this point? With respect to macro economics, does the Administration support the idea that I read about in the morning paper? Namely, that we should back off of Gramm-Rudman-Hollings and have a target less difficult to hit than the $108 billion deficit, which is now the Gramm-Rudman-Hollings target for 1988?

Secretary BALDRIGE. Well, I would say that as of yesterday we certainly did not, and I do not think anything has happened between 8:00 and 10:00 this morning. I think we should shoot for $108 billion.

Senator DANFORTH. With respect to the Government's role, of course, I think some of these competitive ideas are important. If we do get into a second round, I obviously want to get into product liability and so forth. But the macro economics is really the key, is it not?

Secretary BALDRIGE. Well, it is certainly the key to one big door, but there is another door that has got to be opened with another key. That is, individual company productivity.

We can get competitive in two major ways, with some real differences. This country will be competitive. I can make that as a flat statement. It is a question of which way we do it. One way is by increasing the productivity of our companies, and I would say that 66, 70 percent-plus of the increased productivity is up to the individual companies. They bear the major share of the burden on that.

If we do as a country and with individual companies get competitive and get increased productivity enough, we will be competitive. We will have a higher standard of living. We will decrease our trade imbalance, our budget deficit, and so forth.

Now if we do not do that, we are going to get competitive in another way, the only other way, which is the dollar will continue to

slide if we cannot handle this budget deficit, and if we cannot handle our trade deficit by increasing exports and so forth, and if we keep on buying more foreign imports so that we are living beyond our means, the dollar will fall and that will make our goods competitive for the wrong reason.

Getting competitive that way would distinctly and definitely lower our standard of living, and clearly we want to do it the first way. But get competitive, we will; it has got to be one of those two ways.

The CHAIRMAN. Thank you.

Senator Kerry.

Senator KERRY. Thank you, Mr. Chairman.

Mr. Secretary, I know you have long been fighting the battle with respect to the export control regime, and I certainly applaud the efforts that you have made with respect to that. I gather you have won something of a victory with respect to the inclusion in the Administration package of some of those changes.

I have a couple of questions regarding that.

Question number one: Has the Defense Department backed off? And will the Administration in effect be guaranteeing the Defense Department support for the White House legislation?

Secretary BALDRIGE. Yes. The Defense Department will support the White House legislation. I do not like to talk about victories or losses inside the Administration. Let us say that collegially we are moving ahead on this, but they will support the legislation.

Senator KERRY. Well, that is obviously good to hear, because I think certainly I know in Massachusetts, and I know California and other States, they are many companies that have been frustrated to a fare-thee-well by the tension between the Departments and agencies with respect to this, and I hope that support is going to continue.

Can we expect that that support will continue not only as to the legislation and the statutory changes, but will it also be true with respect to the regulatory changes that you have promulgated?

Secretary BALDRIGE. Yes. The proposals that I have made that are not in place now have a time, a short time period attached to them while other agencies have a chance to consult and comment on them.

After that is done, depending on what we come up with, we will go ahead and install them. We have the authority to do that. And we will do so, barring some information coming up that we had not known about before that might change our minds. But I do not think that will be a problem.

Senator KERRY. Well, as I said, I certainly appreciate the work you have done on this. I want to emphasize that I think many of us here are concerned that people understand. I know the Banking Committee has been very involved in this. I think this is a much broader concern cutting across a number of committees and broadly across the issue of competitiveness, and I am happy to hear that we are moving forward on that.

On another issue of concern to me, and I think to the issue of competitiveness, we recently have had 1,500 employees laid off at General Electric in Pittsfield, Massachusetts and General Electric

is effectively moving out, or has moved out of the transformer business.

What is equally disconcerting is that the technology of that enterprise is being moved to a joint venture in Canada with Westinghouse, who is the only other producer of transformers in the United States. Now, I have here a competitive assessment of the U.S. transformer industry which I know you are familiar with, put out by the Commerce Department.

The Executive Summary thereof—this is a year ago—says, "Future for U.S. Large Power Transformer Producers Appears Bleak." It talks about the market problems. It says, "In these markets U.S. producers are at a disadvantage because of cost differentials, the high value of the dollar, and foreign government policies."

Then in the recommendations which it makes, "Options for Review and Evaluation," it says, "Restrictive binational practices employed by major foreign supplier countries have resulted in lack of equivalent competitive access to world markets. Active U.S. government oversight of discriminatory trade practices, accelerated procedures for dumping proceedings, negotiations to obtain equivalent access, and the establishment of counter-measures against countries that will not open their home markets, are options for consideration by the U.S. government."

Now, these options were recommended more than a year ago. Now, a year later 1,500 employees in Massachusetts are losing their jobs. And I would like to know, what was the process for the review of those options? Were any of those options in fact implemented, and if not, why not, and specifically, I believe that there was a specific request of the transformer industry to initiate a 301 action or other countermeasures.

There is a large question in my mind, what happened?

Secretary BALDRIGE. I am not sure of the exact timing of that report, Senator, but you say it was over a year ago.

Senator KERRY. The February 1986, "Competitive Assessment of the U.S. Transformer Industry," prepared by Capital Goods and International Construction Sector Group, International Trade Administration, U.S. Department of Commerce, February, 1986.

This is the report.

Secretary BALDRIGE. We have done about 30 of those competitive assessments since 1983, and I do not pretend that I am proud of this particular time, or sequence of timing, because it sounds like an awful long time, except we do have a lot of work backed up in this area because of a multitude of unfair trade practice cases that we have in the countervailing duty, dumping, 301, 201, so forth.

Our decision on that was to have the strike force look at those allegations, because those were not proveable in that report you had. They were allegations. They were in the stage of allegations.

So, we sent that to what we call the Strike Force on Trade. They made a decision that they should go ahead and seek more information of a hard nature regarding market restrictions, particularly in western Europe, so that they could take action, they could back it up.

We have had our commercial officers in U.S. embassies abroad collecting information on marketing practices, procurement prac-

tices, on heavy electrical equipment, and when that is done, and I will do my best to speed it up, we will then have enough background to then make a decision on whether we should take the 301 action.

We have not been reluctant to take those kinds of actions in the last two or three years. We have done quite a number of them. So, if the facts are there we will do it.

I recognize your point, that this move has already occurred, but that is what we have done.

Senator KERRY. Well, Mr. Chairman, my time is up and it is something I would like to pursue, obviously, and I am not trying to be contentious with you or anything. There is a large volume here, Epstein on the International Electrical Association with significant documentation. This is published in 1980, regarding the existence of an international cartel with respect to this particular industry.

What concerns me, I suppose, and I can only express it and then let my colleagues have their turn, is that we are talking a lot about competitiveness and I am meeting an awful lot of CEO's and other people who are frustrated, you know, beyond description because they cannot get 301 action because these problems seem to exist with ample evidence and there is a backlog.

There does not seem to be an inability to move, and I would love to have you tell us how we, if we can do anything, can help to make sure that we are going to move fast, with swift determinative action so that we are helping our industries rather than seeming to be part of the problem.

Secretary BALDRIGE. I do not know if we have the capacity to absorb many more 301 actions than we are taking. We have taken quite a few. We have taken quite a few in self-initiation of dumping and countervailing duties also.

There are so many products sold in the world that we have tried to keep it down to the ones where we think we have a real case and that are important in terms of size and so forth. First, as Secretary of Commerce, let me say, Senator, that my former business colleagues, and if I was out there now I would probably be doing the same thing, have a tendency to put a disproportionate share of the blame for their lack of sales on foreign competition and imports, unfair competition and imports.

That is a very good hook to hang your hat on if you are not doing well. Now, in this particular case, I am not faulting Westinghouse, General Electric or so—I think General Electric is one of the companies that has done the most toward getting competitive of any company I know of.

It is a fine company, but I think they would be the first to say that the reason that they had to shut down the transformer plant was not due to foreign imports, whether they were allegedly dumped or subsidized, that that business has just—the market for that business around the world has very much dried up and there is over-capacity all over the world in this area.

It is easy, when we get talking about it, to blame the whole thing on that one factor of imports, and I just bring that up in a cautionary measure. If there is a worldwide cartel in this area, I am sure we will find it with these investigations we are making on the

Strike Force and we have never backed away on any—from taking action against any country, no matter how close an ally we are.

We have done it against Brazil. We have done it against Japan. You saw what happened on the wheat and grain and sorghum negotiations we had with the Europeans. We would not on this.

I do know, under the general heading of Ministry of Posts and Telegraphs, that gets more into the area of telecommunications but also includes heavy equipment, electrical equipment, the individual countries in Europe and the Far East guard that market very jealously for their own people and we are going to be looking into that very carefully because here we have opened up ATT, Bell Operating Companies, by the decision that was taken by the court. That has given foreigners a lot of business in the U.S. but we cannot get into their markets abroad.

This may be a similar case. I do not know.

Senator KERRY. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Rockefeller.

OPENING STATEMENT BY SENATOR ROCKEFELLER

Senator ROCKEFELLER. Thank you, Mr. Chairman. I have a statement for the record.

I want to thank Chairman Hollings for holding this hearing today on science, technology and industrial competitiveness.

It is undeniable that our country built its economic prosperity on our scientific and technological pre-eminence. Our economic future hinges on maintaining that pre-eminence. Compelling evidence—by now familiar—shows that we have been neglecting this foundation of our economic strength.

Our high technology sectors—where we took comparative advantage for granted—are facing the same grave difficulties as our basic industries. Just as other countries have erased our edge in semi-conductors, computers and telecommunications, we will face intense competition in the sectors of the future: biotechnology, fiber optics, new materials. Other nations are focusing their enormous talents and energies on significant research and commercialization of the technologies that will pave the way to future economic growth.

For too long, we were unwilling to shake off complacency or face the challenges of a competitive world.

For years, we routinely refused to read the scientific and technical literature from Japan—as if we had nothing to learn from the research of others—while Japanese studied and benefited from the best work done here and around the world.

We casually licensed our leading-edge technologies to other countries: making short-term profits at a very high competitive cost in the long run.

We made the research done in our federal labs accessible to foreign countries without requiring reciprocal access to what they were doing.

We short-changed our space program, placed unreasonable demands on NASA, basked in past glories—and now find ourselves buying launch space from China.

We watched our best and brightest battle to become lawyers and investment bankers, while other nations turned out the scientists and engineers. There has been a steady decline in the number of PhDs in key fields of science and engineering. Moreover, fully fifty percent of the students receiving doctorate degrees in engineering from our universities are foreign nationals.

And those scientists and engineers we did produce—we channelled many of them into working for the Department of Defense. And then wondered why other countries took the lead in breakthroughs in manufacturing and commercial technologies.

The combination of neglect and complacency has taken a serious toll. The erosion has been gradual and long-term; it didn't occur in a day and it won't be reversed overnight.

Fortunately, however, we still have great assets as a nation: including universities that are the envy the world; our network of federal labs; corporate research facilities that still rival those anywhere. If we approach our problems with a sense of urgency—avoiding both complacency and despair our nation can have a resurgence of scientific excellence and technological innovation.

I strongly support the Administration's desire to double the budget of the National Science Foundation over the next five years. I am enthusiastic about the work being done at the Engineering Research Centers and support their expansion. I hope that the Administration will look seriously at legislation introduced by Senator Bingaman, Senator Kerry, myself and others to fund major improvements in university laboratories.

But we should recognize quite clearly that our competitors will not stand still. We should measure our new efforts, not only against our past record, but against the efforts underway in Japan since 1980 to build a network and 19 high-tech cities—Technopolises—throughout the country. These cities are to be the focal points for advanced research in the various "sunrise" industries; they will be the engines for economic growth and prosperity well into the 21th century.

We should set our sights no less high. If President Reagan is serious about this competitiveness agenda, and his commitment to excellence, he will find willing partners in Congress—and the whole nation will benefit.

Senator ROCKEFELLER. Mr. Secretary, the housekeeping matter first. As you know, and we have discussed this before, there are about 10,000 Japanese journals and periodicals of technology that come out each year, and we in this country had been translating virtually none of them, and this has been going on for 25 or 30 years, and the Japanese have been reading everything that we have been writing from our universities and unclassified government industry that over the years has been learning from our mistakes.

With your help last year we got a bill passed which the President signed, which gives us more access and puts on the Department of Commerce the responsibility to begin to translate Japanese technological literature. The funding was very modest and therefore was a foot in the door, but the principle was strong and that is that a country has to understand, in a competitive world, that it has to

learn from others even though it has not been accustomed to learning from others.

You accepted that principle. You understood that principle. In fact, I consider you one of the main reasons that the bill passed, because you got behind it.

Could you catch me up on where we stand now in terms of beginning to implement that process?

Secretary BALDRIGE. In the last few months, we have convened an intradepartmental task force—the chairman is my Deputy Secretary, Secretary Brown—to identify the major activities that respond to this Act.

There are five departmental agencies in Commerce that are spending close to $2 million for this function, International Trade Administration, NBS, Dr. Amber's outfit, Patent and Trademark office, NTIS, the National Technical Information Service, and NTIA.

We have made plans to provide office space at the U.S. Embassy in Tokyo to be headed by a Japanese national, Mr. Adachi, who is presently working at the Department's National Technical Information Service. So, we will have office space in Tokyo and a Japanese speaking individual heading that office.

We have instructed our Economic Affairs Undersecretary, Robert Ortner, to establish a special office in his unit—that is the Economic Affairs, to provide liaison among the Secretary of Commerce, U.S. industry and Congress on all matters pertaining to this Act, and this office will be staffed by a Japanese speaking employee.

Finally, we have arranged for Dr. Kasoota to consult with NTIS, National Technical Information Service, to carry out many of the Act's requirements. He is a Japanese speaking engineer who formerly worked for the Department's National Bureau of Standards. This is just getting off the ground, but I think we are taking the right initial steps.

Senator ROCKEFELLER. It sounds like it, and I would like to keep in touch with you if I could, Mr. Secretary, about that.

On another, broader matter, the Defense Science Board Task Force did a very interesting study which we have been reading about on the semiconductor industry. A moment ago Senator Danforth pointed out that government can only do a certain amount and you agreed with that.

Here, it seems to me that the semiconductor industry is quite an interesting sort of philosophical problem that we are presented with. We understood, I think, in this country that steel and machine tools and other things were going to have difficulties, and there is a sort of a mind set that they certainly are, jobs are being lost, and there are competitive problems.

But, there was a feeling on information, on high technology, for example semiconductors, that we would do very well because we had been on the leading edge of that, but it turns out that we are not. This task force points out that we are in very severe difficulties.

There are some 20 basic weapons systems including some very sensitive ones, where some of the chips now cannot be purchased anywhere except overseas, primarily in Japan. They are not made here. In 1970 we had 14 companies making semiconductor chips.

Now, with the one megabit, we are down to three. The Japanese have eight. And of those three, one is IBM and another is, I guess AT&T. They sell to each other and there is only one left, that being Texas Instruments, which actually produces them commercially.

Now, if one accepts the proposition that the future of information, not just in terms of defense and the ability to defend ourselves but just sort of information generally on a worldwide basis depends upon the semiconductor industry and that every two years it advances by a full generation in terms of the next discovery of a different kind of a chip, is there any—and the Task Force indicates that the government ought to help on this because we are falling behind. We may never catch up without some kind of government help.

Philosophically, how do you respond to that; one, the government should not be involved because private industry has to do it on its own. On the other hand, here is a private industry which is investing 83 percent of its pretax profits into R&D. In other words, they could do no more, I think, on R&D than they are, way ahead of other industries, but they are failing. There is only one which produces commercially and where the clock is being cleaned by the Japanese.

Now, is there a reason for worry in that? There clearly is. And does the government have any role in that?

Secretary BALDRIGE. You know, in the administration and in Congress, I guess when you are asked a question you are always supposed to come out with a short, crisp "yes" or "no" and back it up with some brilliant logic. I am going to have to give you an "I don't know" on this. I am ambivalent on that whole idea.

In the first place, it is not as simple—the state of the semiconductor industry and its future is not as simple as it is often painted. You have to get behind what those chips do and where they are used to really examine who is ahead where.

The chips you are talking about are memory chips. That is the simplest kind of a chip to make. The Japanese used to have 25 percent of that market; we had 60 percent worldwide. Now we have got, worldwide, about 45 percent each but the Japanese have clearly been gaining.

Their gains have come from the fact that they have been very good on a logic chip, the simplest kind of a chip, in putting more and more bits on the chip, and their manufacturing techniques have led the way. There is no question about that.

Also, they have tried to knock out our memory chip people who have mostly smaller companies than the Japanese, by deliberately creating overcapacity in their own factories and sending chips over here, and we found out that they were dumping, and that is a standard business practice with the Japanese in an area like this and that is why we self-initiated the dumping case.

After you have said all that, they are taking the lead in memory chips. The other kind of chips, integrated circuits, IC's, but they are an ASIC, A-S-I-C. I do not always remember the exact computer technology for each of those, but they are custom chips made in rather large quantities in some cases, but made for special pieces of equipment, and/or chips that are a computer on a chip. They are thinking chips as opposed to memory chips. They are logic chips.

In the field of logic chips we are ahead of the Japanese. We, I think, will be able to keep that lead. There is some question about it. But that is where the development of the chip, the initiative, the new ideas of the American engineers and smaller companies, have been able to keep ahead of the Japanese, and they very much want to get into the United States and buy into that kind of expertise.

If they do, we will see our distribution marketing system for those kinds of chips go the way that memory chips have gone. So, we have a problem, and for example Fujitsu wanted to buy out Fairchild. The whole future of this area is too important for us to just come out with a fast yes or no, and I do not like to close by saying I am ambivalent about whether we should as a government partner up with some of the larger chip companies to have a government hand in technology.

I am not sure that would get the job done, Senator. I am not sure it would achieve the results for what we are doing. So, I would have to study that a lot more before I would say yes on it.

Senator ROCKEFELLER. My time is up, Mr. Secretary. Maybe on our next round I could pursue that a little bit more.

The CHAIRMAN. Senator Adams.

Senator ADAMS. Thank you, Mr. Chairman.

Mr. Secretary, it is nice to see you again. I would like to ask you specifically, because this is a more positive note, you really made recently a series of statements of reforms on the export control system. You indicated and announced these last month, and this followed on with the National Academy of Science's report which recently came out that said we are losing about nine billion dollars a year because of our export control system, this being a direct governmental function and one that certainly impacts on our industries.

I want to turn to a specific example and ask you about it, and then ask you generally why certain things were not included in the President's message on competitiveness. I am from the state of Washington. We are particularly interested in the Pacific Rim trade, and of course trade with China.

One change which you are proposing, which I support, would provide for a distribution license for U.S. exports to the PRC. You are still in support of that, are you not, Mr. Secretary?

Secretary BALDRIGE. Yes. As a matter of fact, Senator, I was the Cabinet member who first went to the People's Republic to open up technology transfer. That was an assignment the President gave me about three years ago, and I promised in taking it that I would also keep following up on it after we made the initial proposal to the Chinese which I have done. So, I have followed that quite closely.

Senator ADAMS. I understand Secretary Schultz is going into the area in the very near future; is that not correct?

Secretary BALDRIGE. Yes, and I will be there myself. I forget whether it is April or May, and we will be talking about this then.

Senator ADAMS. Well, now another proposal that has been made by some in Congress, and I have some particular familiarity with this because I have been at the Gwon Cho trade fair and so on, is the potential for licensing for items, in other words, a distribution license that could be used for trade fairs at the time of a trade

show, even though they might not be eligible at that time for an export license.

Could you indicate to me what is your position, and that of the administration is, if it has been formed on that, because having these items out in front is obviously important if we are going to break into that market.

Secretary BALDRIGE. To the best of my knowledge, we have not come up with a position yet on that. Usually in that area the decision comes in whether to leave the piece of equipment there and sell it, you know, if you want to sell one of a kind. We do not want them perhaps to have the whole technology but if we leave it there because it is a lot of trouble to take it back, can they reverse engineer it and so forth and so on, and get something that we do not want them to have as a matter of policy.

I think it would depend, obviously, on the kinds of equipment, Senator, and without having a technical survey on that there is not much way I can answer your question, but I would certainly be glad to look into it and let you know where that stands.

Senator ADAMS. Would you please, because this is—it seems to me that inhibitions on our ability to export, particularly where we have the opportunity and we have the potential for triangular trade out of Japan, are important for us to pursue.

I would like to continue on with export controls because it moves to another area in which we have a great interest and I think the nation does, which is in export of aircraft, and we all are familiar with the developmental costs of Airbus and so on.

It is our understanding that recently the number of U.S. components going into the Airbus construction has been dramatically dropping, and I would like to know the degree to which this is because the European manufacturers are not using U.S. parts and components because our export controls may apply to the entire unit and therefore our entire unit is knocked out because of the control on it.

What is your position on that, because that could knock out our whole component business in terms of the tradeoffs that we have on content of aircraft both with their accepting ours and our accepting some of theirs.

Secretary BALDRIGE. I do not have the aircraft guidelines right in front of me, Senator, but in general if it is a COCOM country manufacturing the aircraft, we would send them those kinds of—we would be able to license those kinds of parts to them because they would have the same strictures we would on what kind of products they could ship under our COCOM rules.

If, however, we had a part that was unique, where there was not foreign availability or substitutability, however you want to put it, we may have to unilaterally control it on re-export if it is a very high technology part or something that we just do not want to see done. But if it is a regular part that there is foreign availability on, we certainly would not have any problem in shipping it to a COCOM country.

Senator ADAMS. Well, maybe in the second round, Mr. Chairman, I can make specific inquiry. And the part, Mr. Secretary, that I will be asking about then is, is the degree of agreement between State, Defense, and Commerce on the re-export control. I am con-

cerned that we have an overeagerness in certain portions of the government to prevent export of products that are capable of substitution simply because these rules have been there a long time and they have not been updated.

I see this as one of the factors that is causing a great cause for concern about diminished ability to supply components abroad.

Secretary BALDRIGE. If I may just take another minute, I think that possibly part of your concern will be solved by one of our initiatives called "Parts and Components," where we are talking about this in the administration now and we will come up with a definite percentage in the very, very near future and that is in effect saying, if a finished product has less than "X" percent U.S. parts that we are concerned about in it, it will not need a license.

It depends on how small you make the percentages, how much good you do our exporters, clearly, so we are having discussions about that now.

Senator ADAMS. Thank you, Mr. Secretary.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Kasten.

Senator KASTEN. Mr. Chairman, thank you, and Mr. Secretary, welcome.

I think we are going to have a trade bill this year. I hope we can have it quickly, and I think, at least from the Senate point of view, we are going to have a bill which I hope that we can all work together on.

I am not sure what the strategy is going to be in the other body. Some are still talking about the desire to send the President a bill that he has to veto, and all sorts of other kinds of political elements. But it seems to me that this whole issue now has become so important to so many of us that we have got to move forward, and I look forward to working with you.

On the President's foreign trade package, or the package that came forth, it introduces the consideration of reciprocity under Section 301 with respect to retaliation against closed foreign markets while preserving presidential discretion. And I anticipate that this area is one in which there is going to be great debate between a number of us in the Senate, some of us on the Bentsen-Danforth bill, this whole issue of the presidential discretion with regard to Section 301.

I just wanted to discuss that with you for a little while because the concern that a number of us have is that the rules, have not worked and there is no way that--whether it is the shoe industry or others who have gone to the ITC industries have received, after all the cost and the time the aggrieved parties, if you will, go through all the legal steps and a determination is made, and then, through this process of presidential discretion, no action is taken.

Now, under those circumstances there is nowhere to go. There is nothing to do, except to alter in some way this presidential discretion and that is what has been done in the Danforth bill.

Is there a way of dealing with this problem, short of simply removing the presidential discretion? The system we have now does not work and it does not, you know, it does not work and we are going to change it.

But going all the way to a complete elimination of presidential discretion, I know the Administration right now is opposed to it. Is there another ground here?

Secretary BALDRIGE. That is a tough question, Senator. I think it is complicated by the fact that until, oh, two years ago, perhaps two and a half years ago when the President came out with a strength in trade policy, we had not taken 301 actions. As a matter of fact, when he announced his strength trade policy in September, I think, of 1985, this was the first administration ever to take a 301 action. I suppose they looked on it as too strong a measure and opening a Pandora's box.

So when you say that it has not worked, I think you have to go back to 1985, 1986 and 1987, and I think on the 301 actions and the dumping and countervailing duty actions, they have been working, not every one but by far the majority has worked and has produced some results.

When you talk about 201, that is really a different area. I am not sure that the word "reciprocity 'is the right word to use when you are talking about making a 201 finding mandatory. I am used to thinking about reciprocal action in 301, and I think Senator Danforth's bill seemed to point that way on areas like telecommunications.

On 201 where a company is pleading injury and in essence saying I am injured so I deserve help and the President has accepted two or three of those, three or four I suppose and turned down two or three, I think that is the kind of discretion that you are talking about that perhaps some Members of Senate would like to take away.

I do not know whether there is a compromise on that. I really am a great believer in some flexibility for the chief executive officer whether it is of the United States of America or of a company or an Army unit. The more you tie a CEO's hands, the more untoward consequences you are liable to have that you do not even see or know about now.

So I instinctively feel, and I would feel this way whether I was inside or outside the Administration, that if you have a boss, in effect, and you tie his hands too much, he is not going to be able to meet whatever the latest contingency is in that particular problem area.

Senator KASTEN. My time has expired, and I hope we can review this in more detail. I think it is important to recognize that a large number of us have kind of come this way because of the experience. We were not here two or three years ago; we would have answered the question the way you just did, that the chief executive ought to have some discretion, but in this process over the last several years, the last few years in particular, a number of us have just looked around and said there is nothing to do except take away that discretion, and that is where we are right now.

But I think in order to have trade legislation pass and pass this year, we are going to have to deal with this question.

Thank you, Mr. Chairman.

The CHAIRMAN. Very good. Senator Wilson, we are in the first round here.

Senator WILSON. Thank you very much, Mr. Chairman. I understand that prior to my arrival a question was asked of the Secretary by Senator Rockefeller having to do with his reaction to Cimetek, the proposal recommended by a panel of the Defense Science Board to assure that our national security is not imperiled by the loss of the capacity to produce semiconductors in the current climate. I gather that the response was one of some uncertainty as to either what will happen or should happen.

Can you tell me, Mr. Secretary, what the status is of the current negotiations between the United States and Japan with regard to enforcement of the semiconductor agreement? As I understand it, Ambassador Yeager has given the Japanese an ultimatum for next week and that a retaliation list was being compiled.

Secretary BALDRIGE. Well, first, on my answer to the question about whether the U.S. Government should join with the semiconductor manufacturers, that was not a proposal to join with them on manufacturing. That was a proposal to join with them, as I understand it, on research and development, and my answer was, as straightforward as I could give it, was I do not know.

That is a very complicated market. It is divided up into ICs and logic chips and memory chips. We are not behind in anywhere near all of those areas. We are ahead in some of the most important ones.

Finally, I did not know, if you did go ahead and do this and the government put up the money and the government had some kind of a say in it, whether you would accomplish what you are trying to do. I mean, I am not sure that the results would be there, regardless of your trade philosophy or free enterprise philosophy or something.

Anytime you get the government and the private sector together with the government having control over what areas you enter into on research and development, it gets to be a sticky wicket. But anyway, that was my answer, right or wrong.

On the semiconductor agreement, that consisted of three things. This is somewhat oversimplified, but not too much. Number one, the Japanese would stop dumping in this country; number two, they would stop dumping in other countries outside the United States; and number three, they would open up their markets significantly more to U.S. imports or exports from the U.S. to Japan.

We are not seeing very much in the way of increased imports. To be fair about it, it is pretty early to tell that. So let me put that as a question mark yet.

Senator WILSON. Increased imports?

Secretary BALDRIGE. Yes; well, our exports, their imports; our ability to sell from the U.S. to Japan. They have held imports, U.S. imports. I say they have held. I believe that it has been held because it has been such a close number. It has been close to 10 percent for five or six years, 9 percent, 10 percent, 11 percent, 10 percent, 9 percent; it went like that. You just do not get those kind of figures by the luck of the draw. There has to be some action that is forcing it.

So we want that opened up. The part of the pact we would have to put a question mark. It is too early to tell yet.

As far as stopping dumping in the United States, that is a success. They have stopped dumping in the United States.

As far as third countries, it is a failure so far. They have not stopped dumping in third countries as they said they would. We have called this to their attention in no uncertain terms, and by March 31, not next week but the end of next month, we have said if we do not see that dumping stopped we are going to take our own set of actions. I would expect us to take some very strong actions if we do not see that dumping stopped, because that was definitely part of the agreement. There is no question or hesitation about that, and for good reason.

Senator WILSON. Thank you, Mr. Secretary.

What rules are we operating under?

The CHAIRMAN. Liberal this morning. We do not have that big a crowd.

Senator WILSON. Let me congratulate you, incidentally, on your recent statement with respect to reforms that you intend to institute on the administration of the Export Administration Act.

From what you said at the time, I gather that your feeling is that there is a problem in terms of attitudes with respect to some who have been actually enforcing the rules on that. Do you think that there is a need for some legislative definitional change?

Secretary BALDRIGE. Part of the program which I espoused requires some legislative action, Senator. Some of it we can do by administrative fiat, but I believe, and I do not have my lawyer here but I believe that the foreign availability proposals would require passage by the Senate and the House. Our proposal is if there is foreign availability in COCOM countries, Western countries, and an item that we were talking about is to be shipped to Western countries, not to the Eastern block, if foreign availability exists it must be shipped and the license must be issued within 20 days. In short, other parts of the government would have 20 days to prove a risk of diversion to the Eastern block from the Western country. If they could not show that, the license automatically gets issued in 20 days.

Again, if foreign availability exists and you are shipping to one of the Eastern block countries, a block country of the Soviet Union, the same thing, except the foreign availability finding takes 120 days there instead of 20 days to show risk of diversion to the Soviet union from a block country.

Further, in this proposed legislation would be a specific definition of foreign availability for the first time. That has really boxed us up in interagency, because how do you pin down exactly what is and what is not foreign availability? We are using the standard definition that has already been passed in one congressional act, and I do not think there should be any trouble about that, but it will greatly aid the speed of the decisionmaking process.

Finally, it just clears up that the Secretary of Commerce has the sole authority in this area of foreign availability.

Senator WILSON. I congratulate you on that. I think that the definition is needed. I think that the deadline before without the attached focus, the definition that is required by a definition of availability has permitted the deadline, in effect, to be honored in a breach. As you pointed out in your statement, what is meant is

that we have lost sales because we have been an unreliable supplier.

So I greeted that announcement with gratitude, and I think that actual implementation of that with the Congress acting on your lead to provide that definition is going to make an enormous difference in the ability of the United States to really remain competitive.

If I may say so, Mr. Chairman, I have changed my own attitude over a period of years, and I am now persuaded that the best way for the United States to maintain a lead over the East or the Soviet Union in the Warsaw Pact is to maintain it technologically, and I do not think that we are going to do that by an overrigid enforcement of the Act as it is now drawn. I think, to the contrary, we will do better by simply accelerating or by providing the kind of climate for research and development that allows us to accelerate change and just stay way ahead of them.

Thank you, Mr. Secretary.

The CHAIRMAN. Very good.

Senator Danforth.

Senator DANFORTH. Mr. Secretary, in 1982 the United States had a surplus in telecommunications trade of $580 million. By 1986 that surplus had been transformed into a deficit of $1.7 billion. Part of the reason was the AT&T divestiture, the fact that the Bell Operating Companies can now buy telecommunications equipment from manufacturers other than Western Electric, the fact that that amounted to a unilateral deregulation or a unilateral trade concession by the United States to other countries while their telecommunications trade is basically closed to what we produce.

Now recently the Justice Department suggests that the Bell Operating Companies be allowed to get into the business of manufacturing. The concern has been expressed by NTIA with respect to digital central office switches that the Bell Operating Companies might enter into joint ventures with foreign manufacturers.

Do you share my concern about the drift in the telecommunications trade, and what do you propose to do about it, if anything?

Secretary BALDRIGE. I share your view. I am most concerned about Bell Operating Companies getting into the manufacturing business if there is no guidelines or an ability to force them on any joint ventures they might make abroad that would freely give increased export potential to Japanese and European companies or any company outside the United States because what you began, your opening statement was exactly correct.

When we broke up AT&T, we gave the rest of the world the biggest individual rollback, in Gatt terminology, a rollback of restrictions on trade. We gave the rest of the world the biggest individual rollback that anybody had ever seen anywhere at any time.

Senator DANFORTH. And got nothing in exchange for it.

Secretary BALDRIGE. And we got nothing for it. We are talking about $2 to $3 billion at least that foreign firms could come into our telecommunications or our telephone area with.

Now, each one of the BOCs averages about 3 to 5 percent of the total switch market in the United States, which is a pretty big chuck of business because the numbers are large. If they begin signing up with the Seamans or any foreign firm, they could seri-

ously damage the AT&T switch business because of the distribution facilities, because in their own case they could use 100 percent of the foreign switch at a time.

You can call that free enterprise and say that ought to be all right, but that is at a time when those foreign governments will not let us into their own markets. So unless they open up, I think we have to have a review process to say yes, you can go ahead and manufacuture but you cannot hook up with any foreign companies in a joint venture and so forth unless we have some kind of regulation on that and have a chance to look at it.

Senator DANFORTH. Mr. Secretary, I would simply add I think there has to be a telecommunications component in the trade bill we are going to pass. But the one other question I want to ask while I still have a little bit of time is to ask you to elaborate, if you would, on why product liability legislation relates to competitiveness.

Secretary BALDRIGE. Well, I would rather have 600,000 small businessmen answer that question than me, Senator. The small business people, when they got to the White House conference last year, surprised all of us on the polls of what they viewed as problem number one that is hurting them that they would like the government to do something about. They came in with product liability.

It was the cost mostly, but also in some cases the availability. Now this year, because the insurance companies had a better year, the availability is at least a little better, but the cost is way too high, and that puts us at a distinct disadvantage over our foreign trade and our partners abroad.

Senator DANFORTH. Thank you, Mr. Secretary.

The CHAIRMAN. Senator Rockefeller.

Senator ROCKEFELLER. Mr. Secretary, just getting back for a moment on the semiconductor matter and, again, the philosophy, I understand the ambivalence, and I see it as genuine.

The Japanese not so long ago, facetiously I hope, presented us with a deal, that what we would do is to produce Cadillacs and Lincolns in the automobile industry and that they would produce the compacts and the subcompacts. Obviously, their way of doing things is to start downscale and move up.

One can point a little bit to the same matter here. You were discussing custom chips. One can point a little bit to the same problem, that they have been doing it at a certain level and that inevitably with their interrelationships, it is not the old integrated Zibotsu but it is something new called the Kayinetsu, which is just interrelationships, like the largest semiconductor company in the world is NEC, and it is part of the Sumitomo Group. It is not integrally related, but it is all relationships, the Sumitomo Bank and all kinds of other products which may or may not be making money, which support NEC, which dominates worldwide semiconductor production.

So one has to look at the future and say that it is inevitable in terms of defense-related specialty chips, custom chips, and then the whole future of the Twenty-first Century of information, communications that the Japanese are going to be predominant.

Then I go back to what I said before. I do not know what else we can do, one company producing commercially. One suggestion which was made, and in fact Dr. Eric Bloch was on that, a member of that, the Defense Science Board Task Force relating to defense semiconductor dependency but it also talked about other things, was forming a consortium of those producers which still do exist. The consortium, the industry would put in about $250 million, I believe they said, and then they wanted the Defense Department to put in $200 million, and they would try to set up how they are going to get the 64 megabit DRAM or how we are going to keep ahead.

Now, that is there. That is the so-called Augustine Report's approach to how do you get ahead or try to keep up with the Japanese or ahead of them eventually in semiconductors.

I just again pose the question to you. I know that on the free trade altar if an industry cannot survive then we simply ignore it. That is a little bit the policy of this administration. I am not sure it is your policy. I do not believe it is your policy. Again, I understand. We have eight steel companies. It will probably in four or five years we will have three steel companies. Maybe in 15 years we will have no steel companies, and that is rather severe, but at least that is called basic industry. This is called high tech, and we are losing that in the same way with respect to semiconductors, I would suggest, as we are with steel or machine tools.

What do we do about that? Is the consortium idea with defense money into it—I mean, setting up a consortium is not the same thing as setting up a Sumitomo Group, but it is an effort to do something. What do we do?

Secretary BALDRIGE. You are talking about setting up a consortium for research and development or for manufacturing?

Senator ROCKEFELLER. Right, for manufacturing processing.

Secretary BALDRIGE. For manufacturing processing. That is the one that would bother me more than the research and development. It is not intended to be just a manufacturing plant for defense work. As I understand it, and we have not taken an administration position on this, but it is a manufacturing plant that would just go out and sell to anybody. That would give me some problems more than the research and development would.

The reason I am ambivalent about that is not because I do not recognize the importance of semiconductors. They are the building block of all of high tech. They are tremendously the most important individual product I can imagine, but you have to divide these in your mind, Senator, really between the logic chips, the tough ones to make that we are ahead in, and the memory chips, the easy ones to make.

Now, I do not mean just give up the memory chip market. We have AT&T, we have IBM making it for themselves, and TI and Microsystems from Idaho making them for commercial purposes, but you do not have just the Japanese on memory chips. Following right on their heels and just stepping on our toes right now, if I can use that example, are the South Koreans, and behind them are going to be the Indians. People have not thought about them yet, but that the largest pool of skilled educated manpower left in the

world, and that is going to end up in five or ten years being big in semiconductors.

So we are going to have a place to buy semiconductors of the garden variety that should not hurt our defense needs. When I say garden variety, I am differentiating. I am saying memory chips. I get very concerned, however, about the integrated circuits and the ASICs. There, you have to work very close with a customer. You almost own the customer. You do not own the customer or the product but let us say you work with them from the very beginning. It is more of a custom affair, although it is big business.

There, if we lost that, we would have lost the technological lead for sure. We need that area because that is the most complicated and the highest technology in the whole chip business. I know we are still ahead in most of that area. I am not sure that going in together with the U.S. Government and trying to produce those would end us up better off than we are now, but as I say the Administration has not taken a position on that yet. I am just expressing my personal feeling.

Senator ROCKEFELLER. Thank you, Mr. Chairman. Thank you, Mr. Secretary.

The CHAIRMAN. Senator Adams.

Senator ADAMS. To follow up on the final part of my export control question, Mr. Secretary, I am concerned that we are putting more and more of our applied research and technology into defense items which then come under the export prohibition list. I know there has been friction in the past between the Commerce Department and the Defense Department over whether or not certain items should be exported.

Our chief competitors in many of these areas, particularly in the high tech field, that we have been talking about, whether it is Japan or the common market and Germany being part of it, are not inhibited by such controls.

Should the Congress be giving new instructions to the three departments, Commerce, Defense and State, on how the list is created and used so that we are able to use our applied research and technology in a more competitive way against those competitors who have not been inhibited by such kinds of controls?

Secretary BALDRIGE. Well, when you say that there has been some friction between some of the departments and the Administration on what should go and what should not go, I am not sure that is exactly the right description, but there have been some differences of opinion that have been pretty strongly held opinions.

The more I see, Senator, the more I think that that is not all bad. It is the timing of settling the disputes that has been bad. And with some of the things we have been suggesting here, we have to get it done in 20 days, or if it is going to a Bloc country, in 120 days, if we can get those settled in that time, I would take my chances as, let us say, thinking about increased exports and so forth, on winning enough of those.

We are, and few people realize this, we are talking about shipping products, machines, to the People's Republic of China and to India and even to the Bloc countries that we would not have dreamed of doing even three or four years ago. We are making progress in that area. In my opinion, we have not made enough

yet. DOD may have a different view on that. They may think we have gone too far. But that process is moving, and I would suggest that before we write any new legislation, that Congress takes a look at what actually is happening with the Administration proposal and the kind of shipments that can go and those that cannot.

We really are embarked on a two-faced process, and I do not want to take too much time on this question, but one is to lift or take off the list things that the present state of technology has passed by, so that we are not spending a lot of time licensing products that, five and ten years ago may have been technologically important, but today they are not.

And at the same time, use the time to concentrate with our allies on the important stuff at the top of the list, so that we are not careless about letting that slip through. So I think we ought to take the present setup and improve it, and that is what I will keep on working to try and do, and I think it has improved.

Senator ADAMS. I am concerned about the same thing that Senator Wilson mentioned earlier. I have come to the conclusion that you have to have an acceleration constantly in the so-called high tech field and in the research field, and that there is a tendency in those who are not directly involved in that field and are more concerned about military applications to stay frozen at a particular point in time.

And it is only by the use of the new cutting edge that you manage to create a new cutting edge. And I see our competitors doing that, and particularly going to the questions that were asked about semiconductors and all Nippon Electric and the various things that have happened there.

One of their big comments on our entering their market has been that we do not meet their quality controls. Whether that is accurate or whether that is not accurate, what it reflects is that they are churning at the margin at a faster rate than we are.

And I am particularly concerned, if we are taking our best research and our best technology, we are using it to develop defense components, which we then place under restriction, where other countries develop those components and move them out into the market, that we ultimately lose. That's the reason for my question.

Secretary BALDRIGE. Yes, well there is some of that. But we have tried to recognize that. The Export Administration Act proposed amendments for 1987, one, and just let me read this because it is part of the Administration's bill, is to establish U.S. objectives for negotiations with COCOM governments, including removal of items from the International Control List, ICL, where controls are ineffective or unnecessary.

Now, I have stated publicly, which I think does bother somebody holding different opinions than I do, but I have stated publicly, that we could take that COCOM list, and I guess on various days I felt we could cut it by 25% and other days by 40%, depending on how silly a particular item is in a day. But we should talk somewhere, 25 to 30%, and that is difficult to get overall Administration approval on.

But I think it is one of the things that ought to be looked at here, because we can do a better job on the higher technical items, where we could all agree on it, and so nobody is getting an unfair

advantage, everybody is stopping it from going, if we take out some of the dead wood. The state of the art has passed us by.

One of the problems is that, by the time some of these highly technical chips, what have you, get into, let us say, our own defense effort on some of the weapons and machines we have, that the state of the art of the technology is ten years old. So we are not protecting that much.

The Soviets are able somehow, at least from what I have read, I am not positive about this, to have their's about seven years old. But, of course, fortunately, their technology is enough behind ours, so that still leaves us ahead. But there is some common sense that should be applied to this.

The CHAIRMAN. Senator Wilson.

Senator WILSON. Thank you, Mr. Chairman.

Mr. Secretary, I note that at page four of your statement this morning you have indicated some optimism about the bilateral free trade talks with Canada, in fact described them as providing, "an unprecedented opportunity to develop rules covering intellectual property in services trade, to be used as a model for the new GATT round."

I would like to think that is true. However, I am greatly disturbed by a comment made eleven days ago by the Canadian Communications Minister, Flora MacDonald, in which she announced a new policy further restricting the ability of U.S. companies to distribute films in Canada.

Is it not more likely, in light of the very restrictive policies that the Canadians have not just announced but strictly enforced, under a doctrine, which I find almost ludicrous, of cultural sovereignty, that what is more likely is that this Canadian protectionism, to call it what it is, is going to be the new model for the GATT round, if we allow it to go unaddressed?

I am really very much disturbed, particularly in light of the fact that GATT does not require the tabling of any of these intellectual property right issues.

Secretary BALDRIGE. Well, GATT does not provide for services, as you know. So one of the first things we wanted to get in the new GATT round was the fact that services had to be covered in it.

There are still some obstacles to a free trade agreement with Canada. I am surprised we have gotten by, frankly, as many as we have. I mean, what you were talking about there, let us just take the general heading of investment in Canada, until quite recently the Canadians would not even allow that to be put on the table, never mind what was said about it. It just was not a subject that they could put on the table.

I do not want to get in too deeply on this, but let us say that I think that is being cleared up. Our own negotiator is reasonably optimistic, that we can get a free trade agreement by the end of the year. Our own people feel that way.

I think the problems that clearly come to the surface and make the headlines now, I think, are more or less expected. Everybody is negotiating and taking a hard line and so forth, but I really think we have got a chance to pull that off. And I think it would be very good if we did.

If we do not, if we stepped into nationalistic practices just before the GATT round, we would all be in deep trouble. That would be the wrong way to go.

Senator WILSON. Let me respond by saying that I think we all share the view that it would be a marvelous thing to get a truly reciprocal free trade agreement with the Canadians. But if we leave off the table some of the most aggravated of the problems, then I do not look to that as any great step forward, whether it be on the threshold of the new GATT round or otherwise, because it seems to me that what we are doing is creating a very alarming precedent in which we invite people to continue to take advantage of us.

So it is no secret, I think, to the Members of this panel and even more to those on the Finance Committee, that I have taken a very dim view of the so-called fast-track procedure for precisely that reason. I appreciate the difficulty of the negotiator. I know that we do not want 535 negotiators at the table.

On the other hand, when last year there was a tie vote on the Finance Committee, I think it indicated that there were genuine grievances because of Canadian protectionism, and I can only hope that those will be resolved. Those that relate to intellectual property rights, I must tell you, I find among the most aggravated and I hope that you and Ambassador Yeutter will bring great force to bear in that area because, like you, I would like to see it go forward, but not at any price.

Secretary BALDRIGE. We all feel that way, Senator, including not leaving the contentious things off the table. Everybody feels that way. And it will either work or it will not. But I don't think we will end up with something in between, a kind of a sorry piece of paper that does not mean much.

The CHAIRMAN. Are you about through, because we do have another witness.

Senator WILSON. Well on a third round, if we get to that, I want to ask you about steel.

The CHAIRMAN. Go ahead now about steel.

Senator WILSON. Well, all right. Let me just put it this way. There are several Senators here from the western part of the United States, Senator McCain and Senator Adams and I. I'm concerned about the VRAs, let me just put it this way. The steel VRAs are a reaction to a section 201 filing. So I think we have to assume for the sake of argument that the steel that is subject to the VRAs has been fairly traded.

Do these voluntary restraint agreements not hurt steel consuming industries, those that fabricate products from basic steel, and make them less competitive? You know, we are providing adjustment assistance for workers hurt by imports, and yet it seems that we are not really looking at those workers who are hurt by very sharp decline in the activity of their industries, the steel consuming and fabricating industries, that is imposed by these VRAs.

Secretary BALDRIGE. Yes, those forces are at work, and you have to figure out who you are helping the most. Again, I want to make this as short as possible, but the steel system did come about because of 201, but not entirely 201. That was not the only force at work.

The fact was that the carbon steel people had also just proven the case against the Europeans on subsidies, so that subsidized steel was flooding into the United States. When the President accepted the 201, the reason we went to quotas for 75 percent of the steel around the world, which was being exported to the United States, was that that was legal, allowable and so forth under settling subsidies that all those countries were using.

The only countries that weren't subsidizing were maybe two or three out of the whole list. The rest of them were subsidized. So, if you settle that by quota, then you can not let somebody else come in and buy subsidized steel at a low price outside that system.

Senator WILSON. Are we making an exception for those that are not subsidizing?

Secretary BALDRIGE. Unless we had signed up everybody, including those not subsidizing, this would not have worked. I mean, the Japanese, the Canadians could have flooded this country with steel. And they were not subsidizing. At least to the best of our knowledge at the time.

So if this is going to work, you have to face up to those facts. If we allow any company, a steel company, for instance, to buy slab at 20% off, it is going to hurt somebody, and we have to give them all the same break. So those quotas, we try to adhere strictly to.

I will be glad, frankly, when that whole five years is up, because that is what they had was five years to spend what they had to to get in shape, because any action like that does distort the market.

We are looking into that whole steel problem now and what happens on chapter 11. That is another big problem facing the steel industry, because we have 30, 40 million tons of over capacity in the U.S., and 150 million tons of excess steel capacity in the world. Yet, you can go into chapter 11 now, and cut your costs, and we can, in effect, by so doing, with lower costs, make it more difficult for people that have not gone into chapter 11. We have got a lot of problems in that area.

The CHAIRMAN. Senator McCain.

Senator MCCAIN. Thank you, Mr. Chairman, and I am aware that we have another witness yet before the Committee and I apologize for the delay in being here.

Mr. Secretary, the issue has been somewhat ventilated already on the semiconductor issue. I understand that, from your previous testimony, you view our record as far as that agreement is concerned as a win, a loss and a draw, that the Japanese have stopped dumping into U.S. markets, that the Japanese market, it is too early to tell as to whether they are opening their market to our products, and it is pretty obvious that there has been an enormous amount of dumping into Third World markets, which have then found their way to the United States.

Mr. Secretary, in my state, which is heavily dependent upon the semiconductor industry, we just had an indication, in fact it has been revealed that we now have a 7.7% unemployment rate. Most of that is due to layoffs in the semiconductor industry.

Those of us, like Senator Wilson, myself and the 20 others who engaged in this year long attempt to find an agreement, we joined with the semiconductor industry in the suit that was brought against the Japanese, are frustrated and angry. And I would like to

know, Mr. Secretary, what will be required in order for the United States to finally respond?

What other further outrages need to be perpetrated in blatant violation of agreements that are solemnly made between two countries what else has to happen before we will trigger a response to what most of us feel is absolutely unconscionable behavior on their part, which calls into question all other agreements, in my opinion, that we have made between ourselves and the Japanese?

Secretary BALDRIGE. The answer to your question is none, Senator. We have said that if Third World dumping is not stopped to our satisfaction by March 31st, then we will take action.

Senator MCCAIN. So by March 31st, we can expect action unless the dumping has stopped.

Secretary BALDRIGE. Yes, sir.

Senator MCCAIN. And there are clear indications that the Japanese market is opening to our products as well.

Secretary BALDRIGE. Well, I think there will have to be a different time for that. I think that should be a little longer. But the dumping should be by March 31st.

Senator MCCAIN. Well I guess we get into a philosophical problem here. I don't know why in the world we can sign an agreement and not expect it to be adhered to, and then have to go another extra mile and warn them again. But I am sure that there is not a ready answer for that.

I would like to switch topics.

Secretary BALDRIGE. Senator, if I could just say quickly there, we are dealing government to government. But these are private companies over there. It goes about one step too far to think that the Japanese government can tell their companies what to do and have them all snap to and salute and do it the next morning. Regardless of what people think, it does not happen that easily.

Senator MCCAIN. Then, Mr. Secretary, then I suggest that we not bother with further agreements, if we do not expect them to be able to exercise influence on their companies to comply.

Secretary BALDRIGE. Well, they are. But I am making the point that it is not as easy. We are much better off with the third country agreement than we would be just putting on dumping duties in the U.S., because they could come in. That is the only reason we put up with this, because it will be more worthwhile if we get it done. But March 31st is the date.

Senator MCCAIN. I will switch subjects, but just saying that an agreement is successful because they have complied with one third of it, to me, is not the way that this country should do business, and just to accept the fact that they would continue dumping chips on our markets without any response on the part of the United States, I think, is also not particularly——

Secretary BALDRIGE. Well, Senator, please, I have been in the middle of this as much as you have. I have been through these negotiations, and that is not an accurate way to describe it. It simply is not.

We are not doing nothing, if they are dumping in the United States, as part of the agreement that we would not put those dumping penalties on. We will put them on on March 31st, if they have not shaped up the Third World.

And I did not describe this as a success. I tried to describe that there were three parts of it. They did one, they did not do one, and the other is a question mark. I was not asked the question, is the overall agreement a failure. I would say, yes, it is a failure right now. And we will act on March 31st if it is not taken.

But it is a frustrating process sometimes to deal with a country that cannot, in spite of what everybody thinks, just automatically control all their companies and that is part of the problem. But the only way to handle that problem is do what you said, put a time limit on it and do not listen to any excuses after that. But we have to listen to the first excuse.

Senator McCain. Thank you. I would like to discuss the subject of maquiladoras, if I could, in what time remains. Many of us who represent border states feel that they are a very important factor, not only in the Mexican economy but in our economy. The majority of the jobs created in Mexico last year, some 200,000, were created by maquiladoras.

A previous witness at another hearing, a representative of the AFL-CIO, claimed that he had no evidence that American companies would not be going overseas, if they did not have the option of maquiladora. Also we have seen the first sign of a tax on maquiladoras by the cutoff of funding for a conference on maquladoras that was held in Mexico.

I would be very interested in your viewpoint as to the viability of maquiladoras, both from the viewpoint of supplying jobs in the United States, as well as Mexico, as well as parts that are supplied that are manufactured in the United States that are assembled on the other side of the border, and if indeed corporations would be leaving the United States anyway and have chosen the option of going to Mexico as opposed to Singapore, Korea or Hong Kong.

Secretary Baldrige. I think the maquiladora system is net plus for the United States, Senator. I think we end up with more jobs.

Now, it is difficult to get hard evidence for that one way or the other. Some of the figures quoted against the idea are far too simplistic. They just take the number of jobs created in Mexico and say, well, you have lost that many in the United States. That is really incorrect.

In most of those cases, perhaps not all, but in the majority of them, you would not be able to compete in the U.S. There is too much low cost assembly operations in other parts of the world, they can compete if they go to Mexico but they can't compete if it is kept in the U.S.

I think the answer is clearly yes, by any common business practical sense, is that if they do that kind of assembly work in Mexico and they can not make out in the United States without doing it, going to Mexico saves them from going to Taiwan or Singapore or Hong Kong. I mean, I am sure of that, but we can always dig up individual cases. It is difficult to make an overall survey, and I do not know if it is worthwhile for every single maquiladora plant, because there are quite a bunch of them.

Senator McCain. Thank you.

The Chairman. Senator Gore.

Senator Gore. Thank you very much, Mr. Chairman. Welcome, Mr. Secretary. I have read through your statement carefully. I

apologize for missing your oral presentation, but I find it a very interesting statement. There is much in it that I find myself in agreement with. I am particularly pleased with your section on intellectual property. I think that there are some real steps forward here.

I have introduced the so-called technological solution on the digital audio tape problem, along with my colleague, Senator Wilson and also Senator Danforth on this Committee, and Senator Kerry, along with Senator Cranston. It has been referred to our Committee, and I am pleased that the Administration is supporting the legislation. I think it is an opportunity for us to forestall a serious problem before it gets out of hand.

I am also pleased to see your discussion on page 23 of advanced ceramics and fiber optics, and if you could provide a fuller discussion of what you think our government should be doing in order to facilitate a better competitive posture for American industry in these two areas, I would appreciate that very much.

I have legislation again referred to this Committee on fiber optics. Well, one bill passed in the last Congress, which has triggered a study, now underway down there, on what would be needed to create a fiber optics network with sufficient capacity, say a giga Baud or thereabouts to connect supercomputers around the country.

Third, I notice on page 1 of your statement, and I do not want to beat a dead horse, but you say that the sixth part of the President's six part program is eliminating the budget deficit. I have just spent a weekend looking at the impact of fiscal policy on our competitive position in the world. There is no doubt that the huge tax cuts and the huge deficits which resulted have dramatically reduced our domestic net investment, as a percentage of GNP. If we are going to deal with the problem of competitiveness, we have to deal with the overall problems of fiscal policy.

I just came from a hearing before another committee, which pointed out that the President's budget submission, by his own figures, do not even get into CBO figures, but using his own figures for the second, third, fourth and fifth years, the President's own submission does not meet the Gramm-Rudman targets. He is over by a minimum of $20 billion in each of the outyears and much more than that in some of them.

So I know that you are not the one for us to holler at about that, but it did catch my eye that this six part program was also going to eliminate the deficit at the same time the President is, in my view, and I will not ask you to comment on this, but in my view he has failed miserably in offering this country the kind of leadership we desperately need from the Executive Branch to get out of this deficit morass that we are in.

Now, finally, because my time is limited, I would like to return to the subject that has already been explored with you by Senator McCain and before that by Senator Rockefeller. I spent a good deal of time with the Computer Science Board of the National Academy of Scientists, and as you know, the Defense Science Board recently

released the report which, I am informed, Senator Rockefeller has explored with you.

Just to add to the points my colleagues have made already, yes, these items are important for our national defense. Members of the Computer Science Board in NAS make a further point, and that is that although semiconductors make up a relatively small fraction of the overall computer business, the control of the semiconductor part of the market gives one the opportunity to exercise enormous leverage over all of the downstream parts of the computer business. The software architecture has implications for hardware, and you can go on and on in delineating the nature of that leverage.

Now, if we determine for defense reasons and for leverage reasons that it is in our national interest to try and organize a national effort to reestablish our competitiveness in the semiconductor business, I think we are going to have to go a lot farther than the measures that we have seen recommended by the Administration so far.

I join with my colleague's description of the agreement that is not working. I am sure you saw the Wall Street Journal two part series on the semiconductor, did you happen to see that?

Secretary BALDRIGE. Yes.

Senator GORE. It is only one of many analyses which shows that it is not working, it is not adequate at all. But beyond that, and I will end on this note, Mr. Chairman, we have got to find some way in this country to spread risk and focus collective efforts within an industry toward a strategic goal. We have got to find an American model, not a Japanese model. It is clear that they have found a pattern that works for them, and we are just surrendering, at the present time.

I did not ask you many questions in my time, Mr. Secretary, but I appreciate the time, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Pressler.

OPENING STATEMENT BY SENATOR PRESSLER

Senator PRESSLER. Mr. Chairman, I have a statement for the record, but I do not have any questions at this point.

I would like to thank you, Mr. Chirman, for continuing with these important hearings on the international competitive challenge facing U.S. industry. The potential and the need for expanding our country's position in world trade is tremendous.

At the first hearing on his important issue, I stressed my interest in furthering basic research programs in science and engineering, both in our universities and in the private sector. I would like to reiterate my suport for increased attention to these basic research programs. This will be a crucial key to success in economic competition and national security.

The road to solving our competitiveness problems should begin with greater finanical support for university-based research. The

real challenge facing us will be creating a strategy which can effectively balance our need to develop long-term competitiveness programs with today's strict budget constraints.

Mr. Chairman, I am looking forward to a very enlightening hearing this morning and know that we will benefit greatly from further exploration of this important issue.

The CHAIRMAN. I thank you, Mr. Secretary, for your appearance here this morning. We will now hear from Dr. Bloch.

Secretary BALDRIGE. Thank you, Mr. Chairman.

[The statement follows:]

STATEMENT OF HON. MALCOLM BALDRIGE, SECRETARY, DEPARTMENT OF COMMERCE

Mr. Chairman:

Thank you for the opportunity to appear before this Committee and talk about U.S. competitiveness. It's a topic that has generated a lot of interest and even more talk in recent days. This is as it should be, because today, the United States faces a major competitive challenge. How we respond to this challenge will largely determine where we stand at the end of this century, and the prospects for future generations of Americans.

THE PRESIDENT'S COMPETITIVENESS PROPOSALS

Mr. Chairman, President Reagan has established the national goal of assuring American competitive preeminence into the 21st century. The package he has just sent to the Congress launches a six-part program aimed at:

1. increasing investment in human and intellectual capital;

2. shaping the international economic environment;

3. better protection of intellectual property;

4. enacting essential legal and regulatory reforms;

5. promoting the development of science and technology; and

6. eliminating the budget deficit.

The President's program addresses many aspects of American society from factory to schoolhouse. The American people in the past have always responded to serious challenges. We need the same response now.

Similarly, while we are prepared to do our share, let there be no doubt that we expect our trading partners to demonstrate an equal commitment to open and fair competition.

The President's proposals call for a partnership between the U.S. government, state and local governments, and the private sector. We are under no illusion that further government action is a panacea for improving our competitiveness, or that we can accomplish many of the President's goals without the aid of the states. In fact, many of our proposals are based on the need to further reduce government's role in private sector affairs.

Nonetheless, the President's program does enlist the broad resources of the Federal Government to help achieve this goal. Each Department is now working on carrying out the President's program. The Commerce Department has been charged by the President with a number of key responsibilities. I'd like to focus on these.

SHAPING THE INTERNATIONAL ECONOMIC ENVIRONMENT

1. Aggressively Opening Markets

This Administration has aggressively dealt with unfair trade practices that limit the ability of U.S. companies to compete in world markets. In September, 1985, the President established the Trade Strike Force, which I chair, to examine, on a continuing basis, all significant trade barriers and determine whether appropriate actions are being taken. The Strike Force has made recommendations to the President on semiconductors, Airbus, intellectual property rights, trade-related performance requirements, and supercomputers. At the same time, the Administration has self-initiated a series of section 301 and antidumping investigations.

The President's competitiveness initiatives call for continued aggressive efforts to open foreign markets so that our full export potential can be realized. The Department has been doing its part. Our efforts have included MOSS talks with Japan, the Kansai Airport discussions, market access talks with Taiwan and Korea, and Market Access Fact-Finding consultations on telecommunications issues with several European governments. We will continue to place a high priority on these and other initiatives to improve U.S. access to foreign markets.

a. Semiconductors

The President's first action in response to the recommendations of the Strike Force was a self-initiated antidumping investigation of 256K dynamic random access memory semiconductors (DRAMs) from Japan. The U.S. semiconductor industry also filed petitions on eraseable programmable read-only memory chips and 64K DRAMs, while the Department initiated antidumping investigations of these products as well. At the same time, the Administration opened a section 301 case regarding access to the Japanese semiconductor market.

All three dumping investigations indicated significant dumping by the Japanese producers. As a result, dumping penalties were imposed on 64K DRAMs. The other cases were resolved through the U.S.-Japan Agreement on Trade in

Semiconductors. This agreement protects the domestic industry from dumping in the U.S., prevents Japanese dumping in third countries, and provides for increased access to the Japanese market.

b. MOSS Talks with Japan

We are making progress toward carrying out major portions of the agreements which resulted from our original MOSS discussions with Japan on telecommunications and medical/pharmaceutical products. We have not completed work on the electronics and forest products discussions, and issues remain in the areas of supercomputers and cellular phones. We continue to work for major changes in Japanese practices in these areas.

The United States and Japan have recently launched talks on a fifth MOSS sector--transportation equipment, including auto parts. We have held several meetings with the Japanese to identify steps to increase sales of U.S. auto parts to Japanese vehicle manufacturers in Japan, the United States, and third countries. We hope to accelerate this process during consultations which are expected to take place before the end of this month.

We are monitoring carefully U.S. sales results in all five MOSS sectors.

c. Kansai Airport

The Department has been heavily involved in the Administration's effort to open Japan's large construction market to international competition. Under Secretary Smart, Assistant Secretary Goldfield and I have met with Japanese leaders on this and have received commitments that foreign companies will be allowed to participate in the Kansai Airport project. We are now working to ensure this commitment is kept and that the United States will be given a fair opportunity to compete for future Japanese construction contracts.

Only limited progress has been made, but the Japanese recently have given more positive signs of their willingness to move forward on the issue (e.g., agreement of the Kansai International Airport Company to improve subcontracting opportunities for U.S. firms and preliminary steps toward increasing transparency of the bidding process).

d. MAFF Talks

The Administration has held several rounds of market access fact-finding discussions with Germany, France, Italy and the EC Commission regarding the European telecommunications environment and related government policies and regulations. We have held less formal telecommunications discussions with Spain and the Netherlands. From these talks we have gained information which will allow us to promote liberalization of European telecommunications markets using a flexible, effective strategy that is consistent with our large presence in these markets and continued trade surplus position.

Partly in response to these discussions, the German Government has announced intentions to take first steps toward liberalization. We will continue to monitor developments to assess the impact of these measures. In the future, the results of our fact-finding effort may point to a need for negotiations or other trade actions.

e. Korea and Taiwan

We have had some success in eliminating specific unfair trade practices in Korea and Taiwan, we are moving aggressively to improve our access to these important markets. Our efforts to improve overall market access involve requests for significant tariff reductions, elimination of restrictions on U.S. imports and services trade, realistic exchange rate levels consistent with underlying economic fundamentals in each country, and significant improvements in intellectual property protection.

f. EC Enlargement

The Administration also has devoted high-level attention to resolution of major trade concerns involving enlargement of the EC to include Spain and Portugal. Following intense negotiations, the EC agreed to compensate the United States for lost feed grain sales to Spain resulting from enlargement of the Community to include Spain and Portugal. This is the first time that the United States has received full compensation following an enlargement of the EC.

g. U.S.-Canada Free Trade Talks

Our talks with Canada on a free trade agreement are closely related to our Uruguay Round efforts (see below), and provide an unprecedented opportunity to develop with the

Canadians rules governing new areas of trade, such as services and protection of intellectual property, which could serve as models for the multilateral arrangements we would like to develop during the Uruguay Round talks.

At this point in the negotiations, both sides have a clear understanding of the issues and, in many cases, of the other's positions. The difficult process of drafting specific language, reconciling differing views, and tackling sensitive issues has begun. Both countries are committed to an accelerated work schedule to complete the FTA talks by the end of this year.

h. U.S.-Mexico Trade Talks

The United States is also committed to negotiating a bilateral commercial framework agreement with Mexico. Last summer President Reagan and President de la Madrid agreed to pursue this important objective. We hope to begin consultations on a framework agreement within the next few weeks and are pleased that Mexico will participate in the Uruguay Round talks as a new member of the GATT.

Our central objective in talks on a framework agreement will be to define basic principles to guide our trade and investment relations with Mexico and to establish a consultative mechanism to resolve bilateral disputes and address opportunities as they arise.

2. Improving U.S. Trade Laws

a. Uruguay Round

The President's competitiveness package contains a number of provisions to increase our ability to improve the international economic environment. Launching of the Uruguay round last September represented a significant step forward in the Administration's longer-term strategy to improve the international economic environment for U.S. business.

We are committed to these negotiations because we believe that an improved GATT system, updated and expanded to meet the demands of today's trading arena, is critical if U.S. products and services are to have unimpeded access to markets abroad.

We are seeking authority to secure agreements in the tariff- and nontariff-barrier area as a key part of the Administration bill.

Specifically, we are seeking permanent fast-track authority to enter into agreements to reduce non-tariff barriers to trade, and ten-year authority to carry out tariff reductions. This type of authority is essential if we are to provide our negotiators with the flexibility and credibility needed to achieve success in the Uruguay Round and bilateral negotiations.

Our principal negotiating objectives are listed in the Administration bill in the key areas where we seek to open markets for U.S. goods and services. The bill provides for more extensive consultations with Congress and industry throughout the negotiating process to assure that their interests are taken into account during the negotiations. Detailed consultation procedures are specified in the bill.

Our preference is to achieve these objectives in the Uruguay Round since GATT discipline commits many countries, both in the developed and developing world, to abide by the agreed-upon rules. However, if progress is slow in these negotiations or if we believe that our objectives could be better achieved through bilateral or plurilateral agreements, the Administration bill allows us to travel that route.

The United States can and should remove self-imposed barriers to competitiveness. But we must look also to the international environment for added improvements.

b. Improving the Antidumping and Countervailing Duty Law

One of the most effective protections enjoyed by U.S. industries against unfair competition from abroad is our antidumping and countervailing duty (AD/CVD) law. Since the Department took over administration of this area in 1980, 618 AD/CVD investigations have been initiated by Commerce. Currently, 183 AD/CVD orders are in effect.

Commerce has conducted investigations on behalf of many of the major industries in the United States. For example, at the request of the softwood lumber industry, we examined the subsidy practices of the Canadian industry. Our investigation and other Administration actions led to an agreement whereby the Canadian government assesses an export tax on softwood lumber products sent to the United States.

The Administration bill proposes four changes to the antidumping and countervailing duty (AD/CVD) law which we believe will make it more effective and fair, while improving the competitive position of U.S. industries. Our proposals would -

- Amend the antidumping duty law as it applies to nonmarket economies (NMEs) by establishing a new benchmark for determining whether NME imports are fairly traded. The new benchmark would be the lowest import price from an eligible NME; e.g., the import price from the eligible NME that has the lowest average import prices. This proposal would, if adopted, replace the present NME provision which the Department and most observers believe to be unworkable.

- Add an anti-circumvention proposal designed to deal with situations where foreign producers subject to an antidumping or countervailing duty order evade or circumvent the order. The proposal would allow Commerce to include within the scope of the order components which are merely assembled in the United States, finished products which are assembled in a third country, and products which are slightly altered in order to circumvent the order.

- Allow the Department, in making price comparisons for purposes of establishing whether there is a margin of dumping, to presume that taxes on home market sales are passed through in their entirety, and allow the Department to subtract any adjustment for such taxes from foreign market value, rather than adding it to the U.S. price. The proposal would override a recent court decisions and make the antidumping statute more administrable and equitable.

- Require the U.S. International Trade Commission to perform an injury analysis with respect to products which are (1) subject to countervailing duties and (2) imported from countries that subsequently become eligible for an injury test. Presently, there is no mechanism for such an analysis. Our proposal permits us to comply with our GATT obligations while preserving relief for U.S. industries.

c. Improving Section 301 of the 1974 Trade Act

Increased use of our authority under Section 301 of the 1974 Trade Act is an important component of our overall bilateral strategy, although we must not expect to resolve the majority of our trade complaints using this mechanism. We have, however, used this approach successfully in the past year to eliminate many unfair foreign trade practices in Japan, Korea, Taiwan, and the European Community.

If applied flexibly and selectively, section 301 can remain a very useful weapon in our fight to eliminate remaining unfair foreign trade practices.

This Administration has a strong record in its handling of Section 301 cases. We have self-initiated cases for the first time, set deadlines for the resolution of longstanding cases and demonstrated our willingness to retaliate when countries refuse to eliminate unfair trade practices.

In a few respects we believe section 301 can be improved. The Administration bill proposes changing the language of Section 301 to provide that, in considering whether a foreign government practice is unreasonable, consideration be given as appropriate to whether reciprocal opportunities are available in the United States. The reciprocity consideration alone would not necessarily determine whether the act, policy or practice was unreasonable. It nevertheless ensures that such an analysis would be considered whenever appropriate, in all section 301 cases.

In cases involving dispute settlement under a trade agreement, the Administration bill establishes a 24-month deadline for the Trade Representative to make recommendations to the President about what action (if any) he should take under section 301.

Under the current law, when a case is referred to multilateral dispute settlement the U.S. Trade Representative is only required to recommend appropriate action to the President 30 days after the conclusion of dispute settlement. However, some dispute settlement cases have languished for years without a conclusion.

While the new deadline does not prejudge what action the President may choose, it may help ensure prompt resolution of cases. Other proposed amendments include: (1) requiring that USTR specify estimated commercial effects of recent Section 301 actions taken; (2) expanding requirements concerning opportunities for public comment; and (3) expanding Section 305 (governing requests for information regarding trade in goods) to include services, investment and intellectual property.

d. Improving Section 201 of the 1974 Trade Act

The bill will amend Section 201 in several ways to improve the usefulness of this section. First, the bill will clarify that import relief for injury from increased imports should be available during a recession or economic downturn. This would legislatively overrule a previous interpretation

by the International Trade Commission (ITC) that a recession or a downturn in a business cycle could preclude import relief because the recession or downturn was a substantial cause of the injury rather than the increased imports.

The second proposal is intended to make Section 201 more adjustment-oriented. The ITC will be required to determine whether import relief is likely to lead to a competitive domestic industry at the end of the relief period. Only in cases where the ITC's findings on future competitiveness are affirmative, would it be authorized to recommend that the President provide import relief. (A new $980 million worker adjustment assistance program is being proposed to assist workers in industries which cannot become competitive as well as other dislocated workers.)

Third, the President will have two additional forms of import relief to choose from when deciding what import relief to grant. In addition to ordering a tariff increase, a tariff-rate quota, a quota, or negotiating an orderly marketing agreement, the bill will authorize the President to initiate multilateral negotiations to address the injury caused by imports or to permit temporary exemptions from regulatory requirements that hamper the injured industry's competitiveness.

Fourth, an expedited procedure will be established for those seeking relief under Section 201 for perishable agricultural products. Under the normal timeframe of Section 201, relief might be granted too late to be effective. A special monitoring procedure will be followed in the ITC to allow for these expedited investigations.

e. Improving the Export Trading Company Act of 1982

The Department is responsible for administering the Export Trading Company Act of 1982. This Act is an important step in improving the ability of U.S. companies to compete in the international arena. The Commerce Department has issued 71 export trade certificates of review under Title III of the Act. These certificates provide antitrust protection to over 300 firms and individuals. Certificate holders report over $300 million in aggregate exports.

Despite these considerable accomplishments, there is a need for changes in the Act to increase the formation and use of ETCs. The Administration bill proposes amendments to the Act to eliminate regulatory and administrative impediments to bank participation in the ETC program, and to resolve uncertainties regarding antitrust standards for firms

operating under the antitrust protection of Title III of the Act.

The banking amendments would lessen the regulatory burden on bank affiliated export trading companies and provide needed flexibility for their operation. The amendments would broaden the definition of export related revenues; permit bank ETCs to export their own services; eliminate the need for collateral on loans that bank ETCs obtain from their affiliated banks; liberalize borrowing restrictions; and eliminate arbitrary inventory limitations.

The proposed amendments would also clarify existing provisions of Title III to provide greater certainty regarding the antitrust protection afforded by an export trade certificate of review. They would unify the current four certification standards into one concise standard; clarify the proper standard and scope of judicial review; reinforce the statutory basis for extending protection to members of an applicant; and, clarify the definition of "export trade" to include transactions in which the United States Government provides funds, financing or other assistance.

f. Establishing the Export Promotion Data System

U.S. companies vitally need access to integrated information to help them explore options and opportunities for increasing their international sales.

The Administration bill calls for the creation of the Export Promotion Data System, to be administered by the Department. The Export Promotion Data System will speed the flow of information to the business community and significantly improve the counseling capability of our 48 district offices by providing them with the tools and the information to custom-tailor information packages for U.S. companies. The Export Promotion Data System will build on the Commercial Information Management System, presently under development by the International Trade Administration's U.S.&Foreign Commercial Service.

3. Improving the Availability and Effectiveness of Export Financing

American firms often lack adequate and competitive financing for exports requiring long amortization periods, such as transportation equipment and power and telecommunications systems. Credit terms and costs can make a 10-20 percent price difference, when

artifically cheap interest rates are extended over 10 years or longer.

All governments of the major industrialized countries promote their exports with credit programs - aggressively in some cases. The Administration's policy objective is to neutralize financing as an element of trade competition.

In 1983, after several years of negotiating effort in the OECD, we succeeded in having the international export credit "Arrangement" revised to require that government financing support be based on market interest terms. In January this year, we also negotiated an ad referendum agreement to restrain the vexing problem of mixed credits.

Concurrently - and equally important - the Administration has liberalized the credit programs of the Export-Import Bank. We initiated a $300 million fund with which to combat mixed credits because we are determined that U.S. business firms be at no competitive disadvantage in offering necessary credit to their buyers. The 99th Congress authorized the Administration to earmark up to $100 million of Eximbank's fiscal-year 1987 $900 million direct credit ceiling to combat mixed credits, but this is not enough. The Administration bill calls for authorizing the full $300 million the President feels is necessary to bring our trading partners to the bargaining table so that these self-defeating practices can be brought in check.

BETTER PROTECTING INTELLECTUAL PROPERTY

Inadequate protection for intellectual property -- trademarked goods, patented inventions and copyrighted works as well as trade secrets -- has a profoundly negative impact on the competitiveness of U.S. industry at home and abroad. We cannot be competitive if the fruits of American ingenuity are being stolen by intellectual property pirates. Intellectual property represents a huge investment by U.S. firms in research and development -- the key to our productivity and competitiveness.

To safeguard U.S. creative competitiveness, the President has proposed, and the Administration bill contains, sweeping changes to U.S. intellectual property and antitrust laws. Our competitiveness proposals would:

- eliminate the "injury" and "industry" tests now required for holders of U.S. rights to defend their interests against unfair practices under Section 337;

- restore to owners of patents on some agricultural and chemical products (such as animal drugs or pesticides) the

time lost as a result of premarket testing required by Federal rules;

- o eliminate the opportunity for foreign manufacturers to use -- without permission, compensation or fear of liability under the patant law -- a U.S.-patented process to make products that compete with those of the patent holder in the U.S. market;

- o enhance the value of a patent by eliminating barriers to patent licensing which are imposed by the antitrust laws and patent misues doctrine;

- o provide a "technological solution" to the potential problem of unauthorized copying of copyrighted materials on digital audio tape recorders soon to be marketed by Japan in the United States and Europe;

- o reduce the cost of defending patent rights in U.S. courts; and

- o offer better protection against the release of commercially valuable information under the Freedom of Information Act (FOIA).

In addition, our Patent and Trademark Office will make its technology file of U.S. patents and English-language abstracts of Japanese and European patents available as a research tool to businesses and universities through private industry or regional search centers.

We also believe it is time for the U.S. to join the Berne Convention, which provides the highest standard of protection for copyrighted works internationally. U.S. membership in the Berne Convention will enable us to gain copyright relations with about twenty countries with which we currently have none, and will strengthen our hand immeasurably in bilateral and multilateral discussions.

We will not stop working to upgrade domestic laws in our attack on counterfeiting, a problem costing U.S. industry $60 billion annually by some estimates.

Improved domestic protection for intellectual property will be part of an international trend that we helped start. Through our efforts even the most serious offenders of a few years ago -- Taiwan, Singapore and Korea -- have moved or are moving toward adequate legal protection for intellectual property. We have high hopes that Malaysia and Thailand will soon achieve a similar level of protection for the intellectual property rights of U.S. business.

We also are working hard to ensure that Uruguay Round negotiations on intellectual-property-related trade problems are as productive as possible.

ENACTING ESSENTIAL LEGAL AND REGULATORY REFORMS

1. Product Liability Reform

Our product liability laws have become a burden on the competitiveness of United States business. As the costs associated with our product liability system, including the costs of liability insurance, climb upward, these costs will be reflected in higher unit prices. This makes U.S. products less attractive in both domestic and foreign markets.

The Administration proposes to resolve this problem by reforming our product liability laws. The President's proposal, among other things, returns the system to one based on fault and ensures that a person is responsible only for those damages directly attributed to his proportionate share of fault. The proposal will promote the interests of consumers and protect the free flow of goods in commerce by placing reasonable limitations on the excesses of current product liability law.

2. Antitrust Reform

Our belief in fair play in an openly competitive market is reflected in our antitrust laws. These laws protect the process of competition, particularly in America's domestic markets. But these laws were enacted, amended, and often interpreted when American business faced no real foreign competition. Parts of these laws no longer reflect the real world in which American firms must now do business. The impact of cooperative efforts or mergers, and so their legality, has often been viewed only in light of other American competitors.
Congress has already recognized the value of joint efforts in increasing American competitiveness. The Export Trading Company Act of 1982 clarifies the application of the antitrust laws to cooperative activity among exporters. The National Cooperative Research Act of 1984 makes it easier for businesses to form research consortia.

The Administration has reviewed the antitrust laws. We have looked for and found parts of those laws which unnecessarily deter joint activity and other pro-competitive practices in the global marketplace. The antitrust proposals embodied in the Administration's bill -

- o update and clarify the antitrust laws governing mergers and joint ventures;

- o reduce triple damages to single damages in most cases in which competitors sue one another;

- o reduce unfairness in the way defendants in an antitrust case share liability;

- o modernize the standards governing persons who would serve on the boards of directors of competitors; and

- o clarify the applicability of the antitrust laws to cases involving foreign commerce.

3. Improving Export Controls.

Commerce is in the unique position of being responsible for both export promotion and export control. Some people have argued that these roles are incompatible. In my view, they are inseparable.

International trade and export controls are not about tradeoffs between national security and economic vitality. Instead, the overall security of this country is comprised of both economic and military security. Moreover, the elimination of overly broad or unfocused controls can enhance our security objectives. Not only can enforcement efforts thereby be concentrated more effectively, but the willingness and capacity of other governments to share meaningfully in the control system is increased. Our reform of the export control system will improve both the level of U.S. competitiveness and the level of U.S. security.

The President's competitiveness initiatives identified seven steps we can take to achieve improvements in this system.

- o Decontrol those technologies that offer no serious threat to U.S. security. The Administration bill would amend the Export Administration Act (EAA) to establish as one of our negotiating objectives agreement in COCOM to remove items from the International Control List (ICL) if the items continue to be available to controlled countries or if the control of the items no longer meets the common strategic objectives of the COCOM members.

- o Strengthen controls on those goods and technologies that are truly strategic. Where U.S. security would be adversely affected if our adversaries were to obtain particular controlled commodities, we must ensure that controls on such commodities are really effective. This step goes hand in

hand with decontrolling those goods and technology that are no longer truly strategic.

- Make procedures uniform and enforcement uniformly rigorous. We will seek agreement with our allies on concrete actions which will make export control procedures more uniform and enforcement more rigorous.

- Strengthen multilateral controls over products and technologies that can contribute to Soviet military capabilities. The Administration bill would establish specific guidelines for U.S. participation in COCOM negotiations. Such negotiations are advisable because unilateral U.S. controls are generally ineffective and enforcement by all COCOM members is essential to effective multilateral controls.

  The bill also provides that the U.S. should encourage COCOM governments to reach and carry out agreements with non-COCOM countries in restricting exports to controlled countries. Adhering to this principle will be increasingly important as indigenous capabilities of third countries allow for rapid diffusion of goods and technology outside the U.S. and the COCOM community.

- Eliminate unilateral controls in those areas where there is widespread foreign availability. The Administration bill provides specific deadlines for foreign availability determinations involving control countries, for a grace period to allow consultations regarding decontrol, and a more precise definition of "foreign availability" to such countries. In making such determinations, Commerce will consult with other agencies, but we will not require the concurrence of other agencies before making a decision.

  The bill also provides that when a licensable product is available to a Free World country from foreign sources without restriction, a license for this product is automatically granted within 20 days (with a 15-day extension possible) unless an unacceptable risk of diversion is demonstrated.

- Reduce the time required to acquire a license by at least one-third, and implement a fair, equitable, and timely dispute-resolution process. Last year, we reduced overall license processing times from 30 days to 20 days. Export licenses for our major trading partners (COCOM) are processed in about 7 days, well below the statutory requirement of 15 days. We will meet the President's goal and further reduce the average license processing times from 20 to 14 days. We are working with other agencies to provide for

more disciplined interagency coordination and expand the role of the Export Administration Review Board (EARB).

- Recognize the continued improvement in U.S./People's Republic of China (PRC) relations and the commitment of the PRC to protect sensitive technology. We intend to work with our allies to further liberalize high technology trade with China. The Administration bill would allow for exports to the PRC under the distribution license. In addition, we will be discussing with our COCOM allies raising the level of technology that can be exported to the PRC without COCOM review.

In addition to these initiatives, Commerce has made considerable strides in reducing unnecessary burdens on U.S. industry through improvements in our export control procedures. Specifically, we have:

- reduced license processing times by one-third during the past year;
- reached agreement with our COCOM partners to improve license processing for the People's Republic of China (PRC);
- installed a new audio response unit - STELA (Status Tracking Export License Applications) - that automatically handles requests for status checks on export license applications using voice-generated technology;
- raised the processing data rate (PDR) levels of computers eligible for export under the Distribution License program. This change will eliminate over 5,000 individual licenses annually;
- reduced the paperwork burden on the export community by authorizing a 24-month validity period for individual validated licenses.
- expanded our export control program, both here and abroad, through our Exporter Outreach staff; and
- established a general license to COCOM countries (G-COM) to authorize exports of some commodities to COCOM countries without an individual validated license. We estimate that the use of G-COM eliminated the need for processing over 12,000 license applications in fiscal year 1986.

Commerce has also initiated several proposals that cut across all seven of the President's export control initiatives. Our proposals will reduce the burden on U.S. exporters, strengthen our relationship with our COCOM allies, and further emphasize our commitment to U.S. competitiveness and national security.

First, Commerce has established two new general licenses which will reduce the licensing burden on U.S. exporters. The General License Cooperating Governments (G-CG) provides for virtually unrestricted export to national government agencies in cooperating countries. Initially, this will be restricted to COCOM countries, with other destinations being added as they develop adequate export control regimes. This reflects our confidence in these cooperating countries to safeguard U.S. goods.

Our General License for Certified End-Users (G-CEU) refines an earlier proposal that establishes a category of certified end-user. Initially, designated commercial enterprises certified to be controlled by COCOM governments will be eligible to use G-CEU. At a later date, this certification will be extended to other enterprises. We hope to expand the list of cooperating countries as well.

Second, we are developing regulations to eliminate, or at least reduce, prior U.S. authorization for reexports into COCOM countries.

Third, we are developing regulations to eliminate licensing requirements for certain low-level exports to our non-COCOM trading partners in the Free World.

Export Administration policy is continually evolving and adapting to cope with the changing nature of both the world economy and the threat to our national security. The challenge for us is to ensure that U.S. policy keeps pace with these changes, and that, consistent with vital U.S. national security and foreign policy interests our export control policy:

- decontrols non-strategic, non-critical goods and technology;
- retains flexibility to deal with changing world situations;
- incorporates new generations of technology and applications without impeding legitimate trade;
- remains a workable, multilateral effort; and
- does not place excessive hardship on U.S. business.

4. Reforming the Foreign Corrupt Practices Act

Our nine years of experience with the Foreign Corrupt Practices Act demonstrate that it badly needs clarification. The business community is not sure what practices are prohibited and what

practices are permitted under the Act. This uncertainty has increased the cost of conducting international business. With U.S. firms meeting fierce competition in the international market place, we cannot afford to place needless hurdles in the way of legitimate exports.

The Administration bill proposes workable solutions to the most significant problems experienced under the Act, while leaving in place strong sanctions against using bribes to obtain business in foreign countries. Our bill would -

- Provide a clear, objective standard to replace the "reason to know" standard for imposing criminal liability on a corporation and its officers when their agents engage in bribery;

- Clarify the Act's provisions regarding the legality of certain payments, such as so-called "grease" payments, to secure the timely performance of routine governmental actions; and

- Reform the Act's unnecessarily burdensome and costly accounting provisions.

5. Repeal of the Cafe Standards

The President has proposed to repeal the Corporate Average Fuel Economy ("CAFE") standards. These standards are no longer necessary as a conservation measure. Oil price decontrol has made the price of gasoline an effective, market-based cpntrol on fuel economy.

In addition, the objectives of the standards have largely been achieved. U.S. manufacturers have virtually doubled the fuel economy of their product since 1975, and the fuel economy of new cars sold in the U.S. has met the goal set by Congress.

Finally, the CAFE standards provide a serious distortion in the motor vehicle market, place unequal burdens on domestic manufacturers, and threaten to cause substantial foreign outsourcing of large-car production and related jobs.

PROMOTING THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY

The President's initiatives focus on maintaining U.S. preeminence in initiating ideas and know-how and translating these ideas into new products and processes. There are a number of proposals, but I would like to discuss the Department's contribution to this effort.

1. Developing Technologies

Most of our firms do not take advantage of our unparalleled technology base. In some cases, our competitors make better use of it than we do. The ceramic engine, which we invented but which the Japanese will soon commercialize, is a good example. Our firms need to take more initiative. Our firms need to use our technology and science base to accomplish breakthrough developments that "leapfrog" existing state-of-the-art products.

The President has spelled out a number of actions in his competitiveness message that address this issue. These include stabilizing the R&D tax credit, carrying out the recently passed legislation to make technology developed at federal labs more readily available to our firms, and issuing an Executive Order allowing federal contractors to retain ownership of valuable technical data developed with federal financing.

In addition, we are exploring new private sector financing vehicles to mobilize private investor funds for technological innovation. And, we are working with individual firms, groups of firms, state and local governmental entities, universities, and federal facilities to organize our technological resources in the pursuit of specific projects.

2. Developing Resource Strategies

Our firms need to explore temporary and permanent alliances with other firms and organizations which will allow them to achieve the critical mass of resources they need to remain viable, both in the U.S. and outside. American firms have little history of cooperation, partly as the result of our antitrust laws. Yet, as the cost of new production facilities embodying the latest technology and R&D accelerates at an alarming rate, many firms need to pool their resources.

In some cases, this might involve cooperative R&D consortia which are now more feasible as the result of changes in 1984 regarding antitrust law. But the problem is broader than that.

Probably the most important single need is investment in flexible computer integrated manufacturing facilities (FCIM). Our firms need these to replace their existing inflexible, dedicated facilities which make it difficult and costly for our firms to bring new products to production. Those old manufacturing facilities have increasingly become an albatross around the neck of our industry. FCIM has truly incredible potential for U.S. firms to regain world leadership.

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The Administration has proposed to modify Section 7 of the Clayton Act to give our firms increased flexibility to make strategic alliances among themselves, as long as these alliances do not harm competition. At Commerce, we are working with the state and local governments, which are concerned with economic development, and with the Department of Defense, which is concerned with America's mobilization base, to help put new joint-use FCIM production facilities in place.

3. Developing Human Resource Strategies

Many of our firms have been slow to adopt new management and organizational forms which will free up the creativity of the American worker or invest in the necessary retraining to make the worker and manager part of the change process rather than an impediment to it. The Japanese have demonstrated that involving their employees at every stage increases their ability to produce efficiently, quickly adopt and fine-tune new production methods, and bring new products to the market. Some of the methods they are using were developed by Americans, yet our firms largely have not employed this methodology. This process is also hostage to our aging production base since the necessary new organizational formats and management styles go hand-in-hand with the investment in FCIM and more aggressive market and technology strategies.

Commerce is exploring with state and local governments and other entities the adequacy of training delivery systems to produce the human resources that our firms need in the new industrial era. Of particular interest is the use of advanced education technology, especially computer interactive videodisc.

4. Commercializing Federal Technical Information

The proposal, embodied in the President's fiscal year 1988 Budget, to take the National Technical Information Service private is an integral part of the President's competitiveness package, and is intended to expedite the commercialization of the non-patentable results of federally funded research.

We are looking at several options for accomplishing this objective. One option would involve a preliminary assessment of private-sector interest in carrying out the NTIS function. A second option would be to create an employee-owned company; i.e., have the NTIS employees take over the business, either on their own, or in concert with a private firm or venture capitalist.

Before we decide which approach to take, there are a number of issues that must be addressed, such as

- Continued availability of Federal agencies' materials.

- The disposition of funds subscribers have deposited with NTIS to pay for publications.

- How to protect employees' jobs.

- The effect that copyright protection may have on attaining a contractor.

We intend to retain control of NTIS until these issues are resolved in a way that assures that the principal objectives of NTIS - to make available the results of Federal research and development to the private sector - is maintained.

5. National Bureau of Standards

No discussion of the Department's role in advancing technology and improving the country's competitiveness would be complete without citing the National Bureau of Standards (NBS). NBS is unlike any other part of the department. In fact, it is unlike any other national laboratory or technical organization in this country. NBS' role of providing measurement-related scientific and engineering research and services is truly one-of-a-kind. Although its work is vital to government, universities, and the public as a whole, NBS is the only national laboratory with the specific mission of directly serving industry.

The bureau has been advancing U.S. industrial competitiveness since it was established at the turn of the century. Many NBS achievements helped to build this country as it became an industrial powerhouse. Since then, entire new industries stemming from new scientific and technological advances have sprung up, and NBS has been playing an important role.

NBS conducts measurement-related work in physics, radiation, analytical chemistry, materials, computer science and technology, electronics, manufacturing engineering, and other areas of science and technology.

NBS also plays a behind-the-scenes role as a neutral, third party, often bringing together industry leaders to confront technical barriers to science and technology advances. These sessions frequently result in new research on critical measurement problems which were not being addressed. NBS also plays an important role in monitoring, and where appropriate and possible, participating in international standards committees. The activities of these rarely publicized groups are more crucial than ever if we are to keep American products from being shut out of world markets.

NBS is helping both mature industries and the emerging technologies which will be critical to our competitiveness in the decades to come. The NBS Automated Manufacturing Research Facility is a perfect example.

The AMRF, as it is called, emerged cut of NBS' programs to help U.S. firms make precisely machined parts. Even in the 1960s, NBS researchers were looking ahead to the future of automation for manufacturers, and they saw that automation would have the potential to change the way both measuring and manufacturing systems worked. They also saw a series of measurement and standardization barriers which would inhibit U.S. companies from taking full advantage of automation. They saw a particular problem for manufacturers who make parts in small numbers -- by 10s and 100s and 1000s rather than by the millions. These small metal-working shops produce a huge share of the goods manufactured in this country, and their performance affects the productivity and profitability of even the largest firms.

Together with industry, universities, and government agencies--notably the U.S. Navy -- NBS researchers have come up with an automation laboratory that is a proving ground for the technology of America's machine shops in the 21st century. The AMRF is an assembly of computerized machine tools, robots, and automated guided vehicles and inspection system put together in such a way that it is the country's most advanced, flexible metal-working shop.

NBS has constructed the laboratory to develop standard methods to link different types of automated equipment together, and to help manufacturers improve quality control by experimenting with efficient and reliable methods for monitoring the performance of automated machinery.

The NBS researchers are proving a revolutionary concept -- one that holds great promise for the improved competitiveness of the country's metal-working industries and for other production processes as well. They have shown that measurement can be built right into the manufacturing process, to make sure that parts can be made right the first time and every time. You get a more precise part with less waste, and you get it a lot faster. Moreover, they have proved the concept of manufacturing by the use of computerized data -- starting with the design phase and continuing through manufacturing and inspection. This is true computer-aided integration.

We already are seeing industry pick up and commercialize the results of work at the AMRF. The Navy is doing the same, as you, Mr. Chairman, know from your participation in a ceremony earlier this month with the South Carolina Research Authority.

NBS is conducting similar important work in other areas where new technology -- and this Nation's ability and willingness to quickly take commercial advantage of those technologies -- will determine our economic well-being and competitiveness.

Nowhere is the impact of new technology stronger and the competition more keen than in industrial materials. The era of commodity materials is waning in the industrialized nations and the era of "designer" materials is at hand. These new materials, such as advanced ceramics and polymer and metal matrix composites, present exciting opportunities for new products and applications. Composite materials are already coming into general use in aerospace. Familiar materials such as alloys and plastics are processed in new ways and are enjoying increased performance and lowered costs. The case is much the same in biotechnology, where the science of genetics has produced a new industry making highly sophisticated biochemical products in the pharmaceutical, agricultural, and chemical industries. In electronics, among the most revolutionary changes is the use of light waves and fiber optics for telecommunication transmission systems.

I highlight these areas because current and planned NBS research in advanced materials, bioprocess engineering, and lightwave measurement is sorely needed in commercializing these emerging technologies, which will be crucial to U.S. competitiveness.

It is also important to mention NBS' specialized laboratories. The bureau has some of the premier research and testing facilities in the country, and several of its laboratories are unequaled anywhere in the world. Many of these facilities have been used for years by the scientific and engineering communities on a cooperative basis.

Recognizing the international competition U.S. firms are up against, NBS has broadened outside use of its laboratories to include proprietary use by companies. Furthermore, the Cold Neutron Research Facility being constructed at the NBS research reactor will be operated as a national facility and will be an important scientific tool for materials science, physics, chemistry, and biotechnology applications.

On the face of it, measurement standards, test methods, and data do not sound very critical when you are talking about national competitiveness. But as one who grew up and made my living working in industry, I can assure you that it is the nuts and bolts details of how you make your product that determine how well it performs, its cost, and ultimately, your success in the marketplace. It is clear to me and to many others who have been examining the state of the U.S. economy that industry has to pay more attention to process control and quality assurance. As in

past decades, the results coming out of NBS laboratories are helping.

To assure that its work is relevant, the bureau's research is often performed through cooperative agreements with individual firms and trade or professional associations. The measurement research NBS performs and services it provides help get technical innovations to the marketplace. The Bureau recognizes that these innovations will get there faster and more efficiently by working closely with industry. For this reason anong others, NBS has literally hundreds of guest researchers from industry and universities working in its laboratories. It is no accident that millions of dollars of equipment is loaned or donated to NBS each year by companies.

That kind of commitment is the best evidence I can think of to show the relevance of NBS' research as we discuss technology and U.S. competitiveness. NBS' mission is narrow in the sense that Bureau scientists and engineers deal primarily with the specialized science of measurement; it is broad in the sense that I am hard-pressed to think of an industry in the United States which does not owe something to NBS. Nor can I think of one which could not improve its competitiveness by paying even more attention to the results from NBS research and activities and the cooperative nature of much of its work.

ADDITIONAL DEPARTMENT ACTIVITIES

One clear answer to our trade deficit, Mr. Chairman, is that we have to export more. Even when we had little competition in our own markets, America was a net exporter. The President's initiatives recognize that America can -- indeed must -- be a force to reckon with in international markets: we must export world-class goods at competitive prices, and we must be reliable suppliers. In addition to the measures I've discussed above, the Department is already engaged in a number of activities that contribute significantly to our ability to compete internationally.

1. Overseas promotion

The Department promotes American business overseas through its trade events programs. Many competitor nations heavily subsidize trade promotion events, underwriting construction, transportation, travel or other costs of trade fair and mission participants. For example, Italy and France subsidize from 50-75% of their companies' direct exhibit costs.

While the Department does not engage in such subsidy programs for U.S. companies -- adopting instead a program of full-cost recovery -- we have a number of programs that allow our companies to develop and act upon opportunities for international sales.

In fiscal year 1987, we plan 99 trade shows along with 43 trade and seminar missions, 18 catalog/video catalog shows and 30 Business Information Offices (BIOs) at major trade shows. In addition, we intend to support a wide variety of privately sponsored or organized events.

These programs make a difference. A recent Department-sponsored software trade mission to Japan generated 108 firm leads for the 13 participating U.S. companies in addition to assisting them in locating potential sales representatives, joint venture partners and licensees. Several million dollars in new sales were generated by this one trade mission alone.

2. Competitive Assessments

The Competitive Assessment Program, which has been underway within the Department for several years now, analyzes the international competitiveness of specific U.S. industries. The underlying premise is that we must examine how competitiveness problems are manifested within specific industries, as well as at the national or macro-economic level, if we are to understand fully the challenges facing United States industry today.

Our studies seek to determine the reasons and underlying causes that contribute to present competitive advantages or disadvantages and factors likely to affect the future international competitiveness of these industries. The assessments also seek to identify policy options available to the Federal Government that offer promise of improving the present and future competitiveness of these U.S. firms in international markets.

Published assessments, in nearly every case, have received positive industry response and have proven effective in increasing U.S. Government/industry communication and interaction. Thirty-six assessments covering a wide range of industries (e.g., from wood and upholstered furniture to biotechnology, software, civil aircraft, and advanced materials) have been published to date. Twenty more are in various stages of completion.

3. Service Industries Development

The Department has integrated and strengthened data improvement, industry analysis, trade promotion and policy support on service industries under the Service Industries Development Program established by the Trade and Tariff Act of 1984. In addition, we have improved interagency coordination and fact- finding on services problems, particularly in the area of regulation. Our resource will be available to U.S. negotiators in the new GATT Round

4. Textiles

Both the textile industry and the Administration have made concerted efforts to improve the industry's competitiveness. Government trade measures have provided the industry with a cushion against the disruptive threat still posed by low wage-cost competition.

The heart of U.S. Government efforts to assist the industry in coping with intense competitive pressures is the textile import control program. The program is conducted in accordance with the framework established by the Multifiber Arrangement under the auspices of the GATT. The basic objective is to seek a balanced equation of orderly marketing, growth of trade, structural adjustment and the avoidance of market disruption. Last year, a revised MFA was renegotiated on improved terms, including expanded fiber coverage.

Under the auspices of the MFA, the U.S. textile program has been and will continue to be aggressive and effective in counteracting import problems:

- Agreements with the five largest foreign suppliers were renegotiated in 1986 and early 1987 to limit their quotas to approximately one percent annual growth.
- 144 categories were called in 1986.
- 129 categories were called in 1985.
- 60 percent of U.S. imports are covered by limits.

Supplementing the our import control program is a special Textile/Apparel Export Expansion Program. This program has helped offset the adverse effects of import competition with export promotion activities for competitive U.S. products, such as home furnishing and industrial fabrics, as well as specialty apparel products.

Our support has focused on apparel. We have funded the Tailored Clothing Technology Corporation (TC2), established to improve apparel industry productivity by automating the labor intensive processes involved in the cutting and assembly of apparel. In all, $1 million in trade promotion funds have been dedicated to the apparel industry.

5. Steel

On September 18, 1984, the President announced a comprehensive steel trade program designed to assist the U.S. steel industry in modernizing and adjusting to international competition. This program emphasizes enforcement of our unfair trade laws and calls for the negotiation of surge control arrangements with countries whose exports to the United States have increased significantly in recent years due to unfair trade practices.

Under the steel program, twenty voluntary restraint agreements (VRAs) have been concluded, covering twenty-eight countries and 75 percent of total U.S. steel imports.

The program has succeeded in reducing the level of steel imports. In 1986, imports totaled 20.7 million tons, a 14.7 percent drop from 1985. This follows a 7.3 percent fall in imports from 1984 to 1985. Import penetration has fallen from 26.4 percent in 1984 to 25.3 percent in 1985 and 23.1 percent in 1986.

6. Machine Tools

On December 16, 1986, the President announced a comprehensive plan to encourage the modernization of the U.S. machine tool industry. We had determined that high levels of imports could potentially erode U.S. capabilities to manufacture critical machine tool product lines. Japan and Taiwan agreed to voluntarily restrain the level of their machine tool exports to the United States for a five year period beginning in January 1987. Imports from other countries will be carefully scrutinized to ensure that they do not undermine the program.

This program will allow the U.S. industry to increase its share of the domestic market and preserve critical production capabilities. The resulting increases in capacity utilization and additional revenues should allow the industry to funnel more investment into research and development.

Due to the industry's vital importance to national security, the President also approved a Domestic Action Plan to facilitate the industry's recovery effort. These measures are not intended to be a permanent solution to the industry's problems. They are intended as a temporary, yet sufficiently lengthy respite so the

industry can improve its competitive position.

CONCLUSION

Mr. Chairman, the competitiveness challenge relates to our ability to maintain forward economic momentum, to continue to improve our national productivity and the quality of life our national economy supports. But we and our trading partners need not view one another as rivals in productivity growth. Each of us benefits from what the other achieves.

In fact, the convergence of living standards in the free world is an endorsement of the increasing efficiency of free markets. As long as both U.S. and global living standards continue to improve, we can feel confident that we are pursuing appropriate policies.

The basic premise of our international economic policy has been, and will continue to be, that the free market system works, and it works better than centrally planned systems. In large measure we have realized the American dream, and others are successfully reaching for the brass ring. We should welcome the challenge and strive to contribute our share to global prosperity.

The President's competitiveness initiative will contribute to our ability to use more effectively our own human and physical resources. But our major trading partners must accept the idea that they need to share in our efforts to maintain a viable global trading system. We must work together to ensure a global economic environment that permits all of us to reach our full potential. Only in this way can we make the most of the possibilities of sustained world growth while limiting the possibilities of economic and political confrontation.

Thank you, Mr. Chairman.

The CHAIRMAN. We appreciate your appearance, Mr. Bloch, and your patience here this morning, and we would be delighted to hear from you at this time.

Do you want to file a statement in its entirety and highlight it? Or deliver it. Either way your wish.

STATEMENT OF HON. ERICH BLOCH, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Mr. BLOCH. Yes, I would like to file it, but I have a few short remarks.

The CHAIRMAN. Very good. The statement in its entirety will be included in the record and we would be delighted to have you highlight it at this time.

Mr. BLOCH. Thank you, Mr. Chairman, for the opportunity to provide an overview of the National Science Foundation's budget proposal for 1988 and to discuss its relation to the Nation's economic competitiveness.

I will pose a number of questions, and then try to deal with those in my short remarks.

The first one is: Why is there such concern with economic competitiveness? The answer is that for too long we have tended to see our economic problems as a result of forces largely beyond our con-

trol, such as unfair trade practices, or low wages in other countries, or unfavorable exchange rates. Concern with competitiveness shifts our attention to ourselves. It makes us realize that the most important thing is simply to stay ahead of our competitors, as was pointed out before by Senator Wilson.

We should not shield ourselves from competition or try to keep ourselves out of the race. We need to run faster and find solutions within our own institutions, and within our own resources.

The second question I want to explore with you is: How can we become more competitive?

The answer is that we must concentrate on new knowledge and well-educated people. These are necessary key elements in a competitive economy. New knowledge, which we get through basic research, is important because it provides ideas for new products that we need to compete in high technology areas. New knowledge also shows us how to raise productivity in low technology manufacturing and the service industries.

Education is important, because talented and well-trained people are the source of the ideas and the main resource needed to put them into practice. There are many other factors that influence our economic competitiveness, but I submit that knowledge generation and education are prerequisites for everything we do.

Another question is: Who in our society is responsible for making us competitive? The main responsibility rests with the private sector. As Senator Danforth pointed out, the Government's role is generally limited to such matters as trade legislation, taxation, and antitrust. But there is one area, I would suggest, in which the Government's role is both central and critical. That is, the support of basic research and education.

This is a long-term matter. Nothing we do here will produce quick results; but in the long term, nothing else we can do will have surer results.

Now, where does NSF fit in in this whole spectrum of economic competitiveness? Concern with the long term means concern with all parts of the science and engineering base. The Foundation, I submit, is the only Federal agency with such broad responsibility for basic research and education in science and engineering. NSF encourages exciting and economically important new areas of research that arise on the boundaries between established disciplines.

NSF supports mathematics, science, and engineering education at all levels of the educational pipeline in ways that integrate education and research. NSF's programs actively encourage cooperation between universities and industry, and between Federal, State, and local governments. NSF is concerned with the needs of developing institutions and developing regions, with undergraduate institutions, and with broader participation by minorities and women.

It is a major strength of our system that basic research and education take place together in our universities, but this makes it essential that we increase our investment in these institutions. That is the central idea behind our fiscal 1988 budget request.

I must say that much has been done already with regard to improving our standing in these areas. Our budget request is in line with rising support by the Administration and Congress for basic

research over the last seven years. Total Federal support for research and development has nearly doubled—from $33 billion in 1980 to $63 billion in 1987; outside of the Defense effort, 39 percent of Federal support now goes for basic research, compared with only 26 percent in 1980;

With strong bipartisan support, the overall budget for the Foundation has risen 66 percent in those seven years, ending a long period in which it was essentially flat. But despite these actions, we still have serious problems with research and education. When compared with our trading partners, the United States ranks only fourth among the industrialized countries in the fraction of gross national product invested in civilian research and development.

The fraction of Federal R&D that goes to basic research and to universities has been dropping as a percent of the total Federal R&D budget. Furthermore, too few of our students are choosing science and engineering areas, and too few of those who do continue to a Ph.D. That is not the way to be competitive. We must invest more in our science and engineering base if we want to solve our economic problems.

Let me talk about the 1988 budget request. We are asking for $1,893,000,000, and that is almost 17 percent above our appropriation for the current year. In addition, the Administration is committed to increases that will double the NSF budget to a level of $3.2 billion by 1992. These increases, projected over a five-year period, establish a strong base from which to plan expanded support for education and university basic research.

Our budget proposal emphasizes three major themes. The first one is education and human resources. Here, as I mentioned before, we mean education at all levels—at informal precollege, undergraduate, and at the graduate level.

The second theme is support for science and technology centers which will receive a 48 percent increase. There will be additional engineering research centers and centers for biotechnology, materials science, social and behavioral sciences, and computer and information sciences. These centers will be located at universities. They will be multi-disciplinary, organized with strong industry involvement, and dedicated to problems that are important to science and important to competitiveness.

The third theme of this budget is the steady improvement of the Foundation's broad support for disciplinary programs and facilities. This is important because, by its nature, basic research is unpredictable. One cannot say in advance where breakthroughs with major economic importance will be found.

Mr. Chairman, last week when the President announced a major initiative to set the United States once again on a quest for excellence, he said specifically that, "Our policies must serve three broad objectives:

"First, generating new knowledge in the sciences and advanced technologies;

"Secondly, swiftly transferring technologies to the marketplace; and

"Third, expanding the Nation's human resource base in science and technology fields."

These are challenges that will be met in part through the programs of the National Science Foundation, but they are long-term challenges. They will be met only by a long-term commitment to strengthen education and research in science and engineering.

The significance of this budget is that it makes that commitment for the long haul. I would be glad to answer any of your questions.

The CHAIRMAN. Mr. Bloch, it must be a frustration, though, to have all of this science research information backed up in the pipeline and not transmitted into the commercial sector. In other words, the Young Commission found that we still spend more on science research than Japan and West Germany all put together, but seemingly we are not commercializing what we know.

Do you have a recommendation along that line that will help us solve this?

Mr. BLOCH. Well, you are right, Mr. Chairman, that we are not as fast as we should be in commercializing our own inventions and our own discoveries. I think the best way of transferring information between two institutions like a university and a company is through people interaction. That is about the best way we can do that.

The engineering research centers and the proposed basic science and technology center are really geared to make that happen. We are asking that industry participate not only in funding these centers and defining the research problems, but also in participating in the research itself by sending people into these centers and then taking them back into their own companies.

I believe very strongly that through this peer-to-peer interaction between industry and universities we could do a lot better than we have been doing in the past when we had a hands-off attitude toward each other and where we depended on papers and symposia—not that that is unimportant. I do not mean to say that.

In the end, however, it depends on how willing industry is to accept many of these ideas, and how willing and capable industry is to translate then into products themselves.

The CHAIRMAN. Well, Dr. Cyert from Carnegie-Mellon attested to the fact that we ought to use the university campuses to orchestrate sort of MITI with NSF. Its purpose would be, of course, to try to guide and engender not only the research but the commercialization of it, and it could best be done at the academic level. He did not want to do it with business; he wanted to do it at the university campuses.

Are you familiar with his recommendation? And if so, what is your comment?

Mr. BLOCH. Yes, I am familiar with it. I would not like to try to duplicate MITI, necessarily. MITI does not work that well, either, many times, we should understand; and we should also understand——

The CHAIRMAN. Where in the Lord's world has MITI failed? I would like to know.

Mr. BLOCH. Well, just look at the steel industry in Japan. They have not done——

The CHAIRMAN. Which industry?

Mr. BLOCH. Steel.

The CHAIRMAN. Steel?

Mr. BLOCH. And shipbuilding.

The CHAIRMAN. They have moved intentionally away from those indistries, because Korea is taking over. They have not failed; they have moved. They go where the market goes and stay ahead of it. But our friend, Senator Adams, is talking about the cutting edge. They do not stick around with textiles. That has gone to India, and Indonesia, and now to the People's Republic of China, but that is not a failure of MITI to know where it is headed.

Mr. BLOCH. I agree on that point. My only point is they have overcommitted many times, also, and did not necessarily get results.

The point I am trying to make is that we should use our own system better. I agree with Dr. Cyert that the universities can do a lot more than they have been doing. For example, I mentioned before, the engineering research centers, working together with industry, offer us the opportunity to do a better job in shortening the gap between fundamental research and improved products and processes for the market place

The CHAIRMAN. Very good.

I do not want to turn this into a budget hearing. Probably we will have another hearing, but will you submit for the record the breakdown of the increase in your budget requested by the Administration, please?

Mr. BLOCH. Yes, I will be glad to do that.

[The information referred to follows:]

The National Science Foundation (NSF) Budget Request for FY 1988 is $1.9 billion, an increase of $269 million or 16.5 percent over the FY 1987 Current Plan. The total includes the following appropriations:

[In millions of dollars]

	Fiscal year 1987 current plan	Fiscal year 1988 request	Change 1987–88	Percent increase
Research and related activities	$1,407.6	$1,635.0	$227.4	16.2
U.S. Antarctic program	117.1	143.0	25.9	22.1
Science and engineering education	99.0	115.0	16.0	16.2
Special Foreign Currency Program	0.7	0.0	−0.7	−100.
Total	1,624.4	1,893.0	268.6	16.5

The CHAIRMAN. Generally we all support that. We are moving. No one wants to oppose research; we need it. But I find it frustrating that we have a lot of it, and we are not using it. So why develop more only to send it to Japan. I have seen many an industrialist come through my office and say, well, I have got the research, I have got the technology, but I cannot get it developed here. It just peeves me—like IBM is now headed to Singapore on communications. They are talking about all these things.

I do not know what is going to jolt us. Like Senator McCain in frustration who says, "What further outrage?" I guess we will have to import Senators and Cabinet Members before this crowd pays attention to what is going on.

Senator Rockefeller.

Senator ROCKEFELLER. On that same line, Dr. Bloch, there was a question of how do you get what is invented in this country put into a manufactured process. We do not reward that, it would appear. Sperry wanted to work on a computer process, upgrade their computer process, and Hitachi came along and said that, well, they would be glad to do the research and development for them on that, and the Sperry Board of Directors went along with that, thus saving themselves a lot of money on R&D.

Well, that was bad enough, because that meant that Hitachi obviously had the technology. But then the New York Stock Market rewarded Sperry with a nice boost in their stock for having saved the money, which strikes me as a very odd way for America to react in terms of keeping our leading edge, and that is the kind of thing you are concerned about.

Now you recognize and you worry about the fact that our students are not going into math and science and engineering, and we all know those statistics. There is a marvelous story, Mr. Chairman, in the New York Times Magazine section this last Sunday about three brothers from Taiwan whose parents had stayed overseas and they had sent their sons sort of to fend for themselves, and they had all won three Westinghouse awards in a row. It was very inspirational.

I guess I want to ask you a couple of questions. One is: Why is it in this country of ours with so much ethnic diversity that more of our young people are not going into math, and into science, and into engineering? Why is that? Number one.

Number two, in that shifting from invention to manufactured processing, is part of the purpose of your engineering research—combined universities and industries into a common purpose—now you are adding on, and I applaud it, I am glad, you are adding on science and technology centers which you say will be based on the proven concept of the engineering research centers, which I guess that means they will expand on that concept.

One, why do not more young people go into this when there is such a critical need? You make an excellent point later on that it is going to get worse because, even if we, in engineering I guess you are talking about here, even if we attract at our 1983 rate in engineering, because of the level off in demographics over the next 20 years, we are going to have a net loss of 700,000 as compared to others. Why do we not go into those? Why do not our young people go into those fields?

And secondly, what real difference—and I want you to answer positively, obviously, in this respect—are the engineering research centers and the proposed science and technology centers of the President, what difference can they make going from research and development to manufactured processing?

Mr. BLOCH. Okay, let me take these two questions, Senator, one by one.

Why do not more of our young people go into science and math? That is a difficult question to answer. There is not one particular fact that would explain it, but I would suggest a number of them.

First, in order to be attracted to math and science, you have got to have something in school that puts this subject in front of you in

a palatable way. You have got to have teachers that know their subjects very well.

Secondly, these are not easy subjects, as you know. So I think you have to essentially, I do not want to say force, but compel people to work in these areas probably more so than in other subject matters. And I think over the last 20 to 25 years we have lost some of that particular drive in high schools. That is why you see the Foundation focusing on programs like television programs, like "Square One" that we just instituted over the last few weeks to capture the imagination and the interest of our youngsters for mathematics.

If you do not do that, and if you do not do that early enough, once you enter college it is too late to make up your mind that you want to become a scientist or an engineer, because you have not satisfied the prerequisites that allow you to do that. So I think we have to focus on the precollege area, in particular, but that is not enough.

Throughout the pipeline, including undergraduate school and graduate school, we lose a lot of the people who might have entered science and engineering careers. We lose them there for a large number of reasons.

To your second point concering what can we do to put manufacturing and manufacturing process development research in the right focus, I am very encouraged that over the last five to six or seven years, a major change has occurred in the country in that regard.

First, there are more universities today that are teaching manufacturing at the undergraduate level as well as at the graduate level than ever before. Before 1982, there were about three or four or five that had formal programs in that area. Today you can find very easily 20 to 30 universities that are teaching that particular subject.

Senator ROCKEFELLER. And that particular subject is making the transformation?

Mr. BLOCH. Making the transformation between a basic idea and manufacturing the product, or manufacturing materials.

Senator ROCKEFELLER. Could you send me something on that, Dr. Bloch?

Mr. BLOCH. I would be glad to.

[The information referred to follows:]

ABET ACCREDITED PROGRAMS IN MANUFACTURING ENGINEERING & TECHNOLOGY

ABET 1985 Annual Report

[A — Associate degree, B — Baccalaureate degree, M — Masters degree]

Institution	Degree	Program
Arizona State University	(B)	Manufacturing Engineering Technology.
Boston University	(B)	Manufacturing Engineering
Bradley University	(B)	Mechanical Design (Option in Manufacturing Engineering Technology)
Bradley University	(B)	Production Operations (Option in Manufacturing Engineering Technology)
Brigham Young University	(B)	Manufacturing Engineering Technology
California Polytechnic State University, San Luis Obispo	(B)	Manufacturing Processes Technology

ABET ACCREDITED PROGRAMS IN MANUFACTURING ENGINEERING & TECHNOLOGY—Continued

[A — Associate degree, B — Baccalaureate degree, M — Masters degree]

Institution	Degree	Program
Central Piedmont Community College	(A)	Manufacturing Engineering Technology
East Tennessee State University	(B)	Manufacturing Engineering Technology
Forsyth Technical Institute	(A)	Manufacturing Engineering Technology
Hartford State Technical College	(A)	Manufacturing Engineering Technology
Houston, University of	(B)	Manufacturing Technology
Indiana University-Purdue University	(B)	Manufacturing (Option in Mechanical Technology)
Memphis State University	(B)	Manufacturing Technology
Massachusetts, University of	(M)	Manufacturing Engineering
Milwaukee School of Engineering	(B)	Manufacturing Engineering Technology
Murray State University	(B)	Manufacturing Engineering Technology
Nebraska at Omaha, Univ. of	(A,B)	Manufacturing Engineering Technology
New York, State University of Utica	(B)	Industrial Manufacturing Engineering Technology
New Jersey Institute of Technology	(B)	Manufacturing Engineering Technology
Norwalk State Technical College	(A)	Manufacturing Engineering Technology
Oklahoma State University	(B)	Manufacturing Technology
Oregon Institute of Technology	(A,B)	Manufacturing Engineering Technology
Oregon State University	(B)	Manufacturing Engineering (Option in Industrial Engineering)
Pittsburg State University	(B)	Manufacturing Engineering Technology
Ricks College	(A)	Manufacturing Engineering Technology
Rochester Institute of Technology (College of Applied Science and Technology)	(B)	Manufacturing Engineering Technology
Rochester Institute of Technology (College of Continuing Education)	(B)	Manufacturing Engineering Technology
Thames Valley State Technical College	(A)	Manufacturing Engineering Technology
Utah State University	(B)	Manufacturing Engineering
Waterbury State Technical College	(A)	Manufacturing Engineering Technology
Weber State College	(B)	Manufacturing Engineering Technology
Western Carolina University	(B)	Manufacturing Engineering Technology

Mr. BLOCH. Let me just focus on the engineering research centers, since you brought up that subject. Many of the engineering research centers are really manufacturing research centers, per se. Let me give you some examples. There is a robotics center in microelectronics at the University of Santa Barbara that is really looking at manufacturing, using robotics in a manufacturing environment that needs clean-room kinds of conditions like semiconductors.

There is an engineering research center at the University of Delaware that is looking at manufacturing processes for composites, not just studying the materials aspect, but also studying how one can handle these new materials in a manufacturing environment.

There is a whole area of net shape manufacturing at Ohio State in an engineering research center—net shape meaning that you do not have to do subsequent processing on it. You can mold a part, for instance, if it is a plastic part, or cast a part, if it is a steel part, essentially in its final net form so that you have a more productive process.

Now with regard to the science and technology centers that we are introducing in 1988, expanding the engineering research center concept is probably not the right word. Rather it is focusing on science in the same way that we focus on engineering through the engineering research centers. This can mean centers on materials, on

certain materials aspects; it can mean centers on biotechnology; it can mean centers in the biological area like plant biology and so forth.

So we are translating the engineering research center experience into broader science areas, again trying to utilize industry as a participant in it, just as we did in the engineering research centers.

Senator ROCKEFELLER. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Adams.

Senator ADAMS. Thank you, Mr. Chairman.

Mr. Bloch, I have been concerned about, and I want to follow along on the questions from Senator Rockefeller. It is true, is it not, that the United States invests less in civilian research and development than any of our major competitors? For example, U.S. civilian R&D spending is about 1.5 percent of GNP, whereas Japan is at over 2 percent and is planning to raise it to 3.5 percent next year. Is that not correct?

Mr. BLOCH. That is correct.

Senator ADAMS. And that is a reversal of the 1960s when the U.S. was spending more. Is that not also correct?

Mr. BLOCH. That is right.

Senator ADAMS. I would like to have your opinion on two potential government actions. One, since we are not investing in civilian R&D, though we are investing in large amounts of R&D, do you think that it is necessary that there be a civilian agency for industrial technology and development with adequate funds? In other words, an NSF for industry? Should we just acknowledge the need for a major new civilian R&D effort at this point in our existence?

I know we are doing a lot of R&D, but I do not see it being translated over into the civilian sector.

Mr. BLOCH. Let me make a comment first on your observation about civilian R&D.

Your numbers are absolutely right. We are spending less as a percentage of GNP on civilian R&D than Japan and West Germany in particular. That is why I believe that the National Science Foundation's budget increase in 1988, and the doubling over the next five years, is a vehicle for bringing that into better balance than it is today. We have gotten out of balance in that regard.

At the same time, while there have been major dollar increases in basic research and university R&D as a percent of the total R&D budget of the Federal Government, both these budget items have been decreased.

Senator ADAMS. Yes.

Mr. BLOCH. Despite these increases.

Senator ADAMS. That brings me to the second question that I have. Which is, the only thing I know that is of glowing excitement that might draw students into the scientific field of particles and utilize some of the talents of people in say the nuclear industry, which is absolutely flat as far as I can see in terms of movement forward into new technology, is the new Super Collider.

What has been the position of the NSF on the creation of that? I know it has been controversial in some parts of the community, but what is your feeling about whether this should be constructed, and over what time period?

Mr. BLOCH. Well, I think that the priorities which the President set in the 1988 budget are exactly right. As you notice, he focused on NSF in particular. He focused on the doubling of the NSF budget. And I think that is a prerequisite for doing something like the SSC or the Space Station. If you do not have the basics right, then I do not believe you can be successful with an SSC or a space station.

And he set the basics right: namely, focus on education. Go produce the right number of people who can do all these things. Building an accelerator such as the SSC is not an easy one; it is a very complex one. So is the space station. You need to make sure the basic knowledge base is there that will allow you to build an SSC, and a space station.

I think the priorities are absolutely right, and I would think that if the SSC comes into being, it should come into being after we have set these bases in place. The ten-year time frame for the SSC is probably right, allowing us to focus on the necessary underpinnings through the Foundation's budget and basic research support in the Federal Government as a whole.

Senator ADAMS. What is your feeling on the timing on that?

Mr. BLOCH. On the total?

Senator ADAMS. On the SSC and follow-on for the basic research facilities.

Mr. BLOCH. I think the SSC is a good 10 years in the making. You could not expedite it much. I think we should start on it. I think we should do the necessary research on superconducting magnets which are very important to its success: but, we should not forget that at the same time we have got to put enough money into basic research and university research through the Foundation's budget, and other agencies' budgets.

Let me comment on your question about the superagency, or the new agency for civilian research, or civilian research and development. I am not so sure. That is a proposal that has been advanced from time to time. I am not so sure that that is necessary. We have enough bureaucracy in this town. I think if the budget priorities were set properly—and by that I mean enough money in basic research—enough money in university R&D, and executed by the various departments, then you would get the same benefits as from setting up a new department of science or civilian research. But that is my personal opinion.

Senator ADAMS. Thank you, Mr. Chairman.

The CHAIRMAN. If you do not mind–well, go ahead, Senator Wilson.

Senator WILSON. Thank you, Mr. Chairman.

By the way, I was going to remark in response to your comment about importing Cabinet Members or Senators that I have not heard of any great demand for the export of Cabinet Members or Senators. Retirement, but not export.

Dr. Bloch, I am intrigued with the possibility that has been much discussed lately of the use of personal computers as teaching devices in our schools. The point that you make about education of people for us to assure competitiveness as the most basic requirement is a point with which I firmly agree.

I am curious, therefore, to put it mildly, about at what point in the future we may expect to have personal computers at the desks of students in their classrooms. This is occurring on a limited basis now, I know, but what I am curious about specifically in order to make that happen is, it seems to me that the computer companies now have the hardware, and it can even be argued that at this point already that hardware is cost effective. But what about the software?

Is it ready for mass use in classrooms? Is that now something that we can say is cost effective?

Mr. BLOCH. Well, I think you are focusing on the right area—namely, the software to be used in conjunction with personal computers. I do not believe that we are at the point today where computers in high schools, or elementary schools, or kindergardens are used in a very effective way.

There are many things we do not understand about how to use computers in schools, and programs and software are very difficult to develop. They need to be experimented with and tested. I am familiar with one particular program which was used in kindergarden called "Writing to Read," which essentially was trying to teach reading to kindergarden children by working with a computer.

But I think out of that particular program, a lot of insights came on how one can use a sophisticated tool like a computer. I believe we have to learn a lot more. We should experiment with it. We should fund many of these efforts so that we understand and can learn from them.

I do not believe that one can go in overnight and utilize computers on every desk in a productive way. A lot of work has to be going on. Even in colleges and universities, it is not clear how best to utilize computers.

Senator WILSON. So what you are really saying, it sounds to me, is that just as it is one thing to write a novel and another to produce a screen play from it, and that there is the requirement for the special skills of the screen writer, there is the need to be able to take the classic textbook and adapt that in terms of really translating it into the kind of computer program that would be required to allow individual instruction.

Let me ask you another question. Let us assume for the sake of argument that however far away that is, the time is coming—as I believe that it clearly can; and it already has on a selective basis—but we have got a problem, too, that in terms of providing for this particularly literate group of people that we will be required to have to be competitive, literate especially in mathematics and the sciences, we are obviously dependent upon the classroom teachers to achieve that goal. And yet, we have a number who are aging assets.

There is the thought on the part of some that some of the cost of education can in fact be addressed over a period of time in a way that will allow for not the loss of jobs by teachers, but rather the use of computers with teachers performing a role as facilitators and relying particularly on the use of computers. But the question really arises, what has been the response, if any yet, from the teachers' unions with regard to this possibility?

Has there been any apprehension suggested that machines may be replacing people and displacing them from employment?

Mr. BLOCH. I am not an expert in that particular area to tell you what teachers' unions think about it, but I have seen a tremendous change over the last few years in that regard. Namely, that teachers' unions and teachers themselves are a lot more eager to utilize new approaches like computers, and new technologies much more than in the past.

I think we are overcoming the problem that you are citing. I think it is recognized today that the demand that exists, regardless of computers, for replacement of an aging population is such that we can hardly meet.

Senator WILSON. A final question for the record, since my time is up. If you are aware of it, Dr. Bloch, are any of the computer companies who would stand to benefit substantially from widespread use of computers in classrooms prepared at this time to act as the financing agent for school districts in acquiring large numbers of personal computers? In other words, is there a GMAC out there waiting to finance the dissemination of high technology as a teaching device into our classrooms?

Mr. BLOCH. I do not know if there is such a thing as a GMAC, but I have observed not only in pre-college applications, but also in universities and colleges that over the last three or four years since personal computers came into their own, there has been a tremendous push by all of the computer companies to get their products into universities and even into high schools and elementary schools at great discounts.

I do not know of any financing schemes, per se, but certainly great discounts.

Senator WILSON. You are not aware of any legal bar to their doing that?

Mr. BLOCH. I am not aware of it, but I am not an expert on it.

Senator WILSON. Well, perhaps speaking of competitiveness, that will supply the answer.

Thank you very much.

Mr. BLOCH. Thank you.

The CHAIRMAN. Thank you.

Jay?

Senator ROCKEFELLER. Just one brief comment, Mr. Chairman.

I want to write you a letter, Dr. Bloch, about a couple of matters, but I just—in going over your background and listening to you, and reading your testimony very carefully last night, and knowing something about you, I think that we are very lucky to have you where you are. You are an instrument of change, and you walk that very difficult line between the pressure from scientists and academicians who want you to deal only in the multi-disciplinary theoretical area, and yet on the other hand while you respect that you are trying to drive this country towards being more competitive. You are an electrical engineer by training, I believe, and you have had an extraordinary life.

It just occurs to me, from time to time, that it is important to tell people who sacrifice other opportunities to serve in the government, that the government is very lucky to have them. I feel that way about you.

Mr. BLOCH. Thank you.

The CHAIRMAN. Mr. Bloch, I feel much as the Senator from West Virginia. The only thing that I had wondered about was your answer supporting that $4.5 billion for the Collider rather than, say, for the scientific centers, or for the National Science Foundation to develop these programs on the university campuses. You know how thirsty these programs can be. We all know the example of the Research Triangle down in North Carolina.

Similarly, we have had Porelli and the optic cable folks come into the University of South Carolina. We are developing computer centers there. Other universities are doing it. They could sop up and really use, in a more productive way I think, those funds, rather than spending it on a $4.5 billion Collider. I can understand advancing science, but that is not my main problem right now. I am falling way behind, and I need more than just the $300 million that you are trying to add on.

Do you not want to comment further and get your program moving more than that Collider?

Mr. BLOCH. Thank you, Mr. Chairman. Your invitation is very tempting, obviously.

The CHAIRMAN. Yes, sir.

Mr. BLOCH. But let me say that I believe very strongly that we need a balance in all of these things. I said before, and I say——

The CHAIRMAN. I am trying to correct the imbalance. I know what the balance is——

Mr. BLOCH. Well, that was my next point.

The CHAIRMAN. From the starting point, I am way behind. No one else has got a Collider, so that balance has been corrected. I am trying to talk about the imbalance in the development of our technology and basic research.

Mr. BLOCH. That was exactly my point. I think when I said before that I think the President set exactly the right priorities, he moved forward in doubling NSF over five years.

The request that I had in to OMB was a doubling over three years. So if you want to correct our request in that regard, I will not argue with you.

The CHAIRMAN. Well, good.

Mr. BLOCH. But I also believe that we need a balance. Such a thing like an SSC is important, too. It is important for us to stay at the forefront, and I think if you do it judiciously, and if we do the right balancing act that I discussed before, then I think we could have both.

The CHAIRMAN. Very good, sir. We appreciate very much your appearance here this morning.

Mr. BLOCH. Thank you.

[The statement follows:]

STATEMENT OF HON. ERICH BLOCH, DIRECTOR, NATIONAL SCIENCE FOUNDATION

Mr. Chairman and members of the committee: good morning. I am glad to have the opportunity to provide an overview of the National Science Foundation's budget proposals for 1988 and to discuss their relation to the Nation's economic competitiveness.

I would like to start by saying how much the Foundation and the academic science and engineering community has appreciated the support that this committee has shown in recent years. As ther administration has sought to shift the Nation's

attention to the issue of economic competitiveness, this committee has been among the first to understand the importance of basic science and engineering and to make the necessary investments.

It is high time that economic competitiveness move to center stage. For too long we have tended to see the source of our economic problems as outside of ourselves: The results of unfair trade practices, or low wages in other countries, or unfavorable exchange rates.

Recently we have realized, as a nation, that if we want to compete successfully, the most important thing is simply to stay ahead of our competitors in creating ideas through basic research, and turning them into high quality, innovative products and services for the market place.

Many forces must come together to achieve economic competitiveness. But our key assets are new knowledge and well educated people.

Why is research important?

Research is important to competitiveness because, over the long term, it provides ideas and new knowledge for the products that we need to compete in high-technology areas, and the process improvements that can raise productivity in low-technology manufacturing and service industries.

In quantitative terms, technological innovation created through research has been responsible for nearly half of all productivity gains since World War II. Research has been far more important than economies of scale, for example.

Many of NSF's programs support this process of innovation: robotics, engineering research centers, biotechnology, materials research, education of future scientists and engineers, and many more.

Seeking productivity through research and technological innovation is the right way to enhance international competitiveness. It is far preferable to reliance on trade barriers or other protectionist measures.

Why is education important?

The science and engineering base on which we depend consists of three elements: People, facilities, and equipment.

Of the three, people are by far the most important. Well trained people are the source of the ideas and the knowledge which make technological innovation possible. A dynamic productive economy depends on a steady flow of new ideas, and a steady flow of well-educated people to turn them into successful products.

Facilities and equipment can be had relatively quickly—it only takes enough money. People, however, come only through a long process of education. For a scientist or engineer, the process begins in junior high school and continues through undergraduate and graduate training: In all, a dozen years or more.

The length of time this requires makes it imperative that we have a continuous flow of the most talented young students into science and engineering programs.

This must be done through conscious policy. We cannot depend on market demand to ensure that we have the necessary numbers, for the market fluctuates much too rapidly. The educational system cannot respond rapidly when demand goes up and finds itself producing surpluses when demand is down. That is why it is so important to increase our investment in universities.

The Government's ability to affect our competitive position is limited. Government clearly has a role with respect to such matters as taxation and the clarification of antitrust legislation with respect to joint ventures. But for good reasons much of the initiative and responsibility rests with the private sector. There is one area, however, in which the Government's role is both necessary and clearly beneficial: the support of basic research and education.

That is why the National Science Foundation plays an increasingly critical role in achieving long term economic competitiveness. NSF does this by providing linkages among the vital elements of the research base.

NSF supports all areas of science and engineering in an coordinated way. By concentrating on support for universities, it also integrates research and education. This is a major strength of the American system of research universities.

NSF has been a leader in finding ways to link research in industry with university programs, so that the strengths of each can reinforce the other. NSF actively reaches out to industries, universities, and local institutions to develop cooperative activities and leverage the taxpayer's dollar.

NSF is also concerned with developing institutions and regions, and with broadening the participation of minorities and women, because we need these resources for the health of our system in the long term.

Our budget request for fiscal 1988 is $1.893 billion. That is a substantial 16.7% above our appropriation for the current year. Of equal importance, the administration is committed to increases at a rate that will double our budget, to a level of 3.2 billion dollars, by 1992.

These increases, projected over a five year period, establish a strong base from which to expand support for education and university basic research and plan for the future.

Our budget request is in line with the rising support by the administration and Congress for basic research over the last seven years.

Since 1980, the administration has nearly doubled total Federal support for research and development, from $33 billion in 1980 to about $63 billion in 1987.

Outside of the defense effort, 39% of Federal support now goes for basic research, compared with only 26% in 1980.

With strong bi-partisan support, the overall budget for the foundation rose 66% between 1980 and 1987, ending a long period in which it was essentially flat.

These actions have been critical in helping to stem a long decline. But we are continuing to experience serious problems with research and education while our trading partners are increasing their investments in R&D and in the production of science and engineering personnel.

As our society becomes more and more dependent on technology we must be sure that we do three things:

Support basic research adequately;

Educate enough new scientists and engineers;

Invest sufficiently in research facilities and equipment.

Support for basic research:

Chart 1: The administration has moved strongly to reverse the declines of the last twenty years in investment in basic research. High levels of such investment are necessary for sustained growth in a modern technological society.

Chart 2: However, our rate of investment in civilian oriented R&D should be further increased.

Chart 3: We should strive to remain ahead of our major competitors in civilian R&D—especially Japan and West Germany.

Chart 4: The proportional share of Federal support going to the universities should be increased.

Chart 5: An encouraging trend is that our Federal expenditures for domestic R&D are increasingly for basic research. Development expenditures are, quite properly, being left to industry.

Is there an optimum level of support for basic research?

There is a no simple answer to that question. But when:

Basic research is dropping as a proportion of total Federal support; and

We see increasing competition from our trading partners; and

We see shortages of scientists and engineers developing in some fields; and

Facilities and instrumentation in universities need modernizing;

Then we can only conclude that a significant increase in basic research support in the universities is needed. That need is recognized in the administration's proposal to double support for the universities through the NSF over the next five years.

The people problem:

As society becomes more dependent on technology, a larger fraction of our population must be educated in science and engineering. However, this fraction is declining: We are attracting too few young people to these areas.

Chart 6: Twenty years ago, the United States had far more scientists and engineers per capita than any of our competitors. Today that is no longer the case.

Chart 7: The proportion of our young people who are being attracted to scientific and engineering programs has remained flat, when it should be increasing.

Chart 8: Even if we could continue to attract students at the 1983 rate, the decline in the number of 22 year olds means that we would produce nearly 700,000 fewer baccalaureates in these fields in the next twenty years.

Chart 9: Our PhD production as a percent of bachelor degrees in science and engineering is declining. In fact, in many important fields, the total yearly production of PhD's is declining in absolute terms.

Our budget proposals for 1988 are focused on dealing with these issues and giving a renewed emphasis to basic research and support for universities.

Three major themes are emphasized in this budget:

Education and human resources.

Science and technology centers.
Disciplinary programs and facilities.
We are making major efforts to concentrate our resources and make real improvements in each of these areas.

Education and human resources

The first theme is education and human resources. The Nation's science and engineering base—the source of our ability to do basic research—is made up of people, equipment, and facilities.

Of the three, people are the most important. Reflecting its priority, our budget proposes a 50% increase for education and human resources. This will support 200 additional graduate fellowships, increase the number of Presidential young investigators by 200, and support special efforts to increase the number of women and underrepresented minorities.

The number of scientists and engineers cannot be increased quickly, because their education takes many years. It is particularly important that we identify the most promising students early, and encourage them in every way possible to stay with science and engineering.

We must also intensify our efforts to recruit more women and minority students to these fields. This is not only a matter of equity: We simply cannot afford to waste the talents these people have.

Science and technology centers

The second theme is the establishment of science and technology centers. These are university-based multidisciplinary research centers, each with strong industry involvement, working on problems that are scientifically important and relevant to industrial technology. This is the program that the President announced in his state of the Union address.

The close coupling of industry with academic research that these centers provide will substantially improve technology transfer from research labs to factories and to the marketplace.

At the same time, science and technology centers play a part in the education process because they involve graduate students, and even some undergraduates, in research on important problems. The result of that research will find its way into improved curricula.

The proposed 48% increase will be applied to the establishment of new centers based on the proven concept of the engineering research centers. These would include additional ERC's, biotechnology centers, as well as centers for materials science, social and behavioral sciences, and computer and information sciences.

Disciplinary research

The third theme of this budget is the steady improvement of the foundation's traditional broad support for disciplinary programs and specialized research facilities, for which we are proposing an increase of 10% with special focus on global geosciences, biotechnology, materials science and engineering, and the continental lithosphere program.

Solid support across all the disciplines is important because by its nature, basic research is unpredictable; one cannot say in advance where a breakthrough with major economic importance will be found. But we know from exprience that they will be found.

Let me give you an example of that that I found striking: A problem in basic research in astronomy a few years ago was to develop calculations that could determine the properties of objections that are occluded by the Moon. No one could have predicted that this same process of calculation would become the basis of an important modern medical technology called computerized axial tomography: the "cat" scan.

These jumps from basic research to applications can almost never be foreseen, but they have happened so frequently in the past that we can be confident of the ultimate value of the investment.

Summary

The NSF budget for fiscal year 1988 and future years will allow the Foundation to improve research and education in our universities and colleges in very important ways:

Science and technology centers;
Mathematics, science, and engineering education at all levels of the educational pipeline;

Broader participation of institutions and underrepresented groups;

Cooperation between Federal and State governments, industry, and academia; leveraging taxpayers' dollars in the process;

Transfer of research results from universities to industry.

Mr. Chairman, all these activities are important for the long term economic health of our Nation. Through them, the Foundation will make significant improvements in research and education at our universities and colleges.

Even more important, the commitment to continued growth will keep basic research and education in science and engineering on a steady upwards track. I believe strongly that nothing is more important for the long term economic health of our Nation. And I look forward to working with you and with the entire Congress to make sure that these proposals are turned into actions.

The CHAIRMAN. Thank you.

The Committee will be in recess to the call of the Chair.

[Whereupon, at 12:12 p.m., the Committee was recessed, subject to the call of the Chair.]

[The following information was subsequently received for the record:]

[Report Memorandum #98, Apr. 23, 1986]

JAPAN'S KEY TECHNOLOGY CENTER SELECTS 25 R&D PROJECTS FOR CAPITAL INVESTMENT

On March 31, 1986, the Japan Key Technology Center [1] announced that it has selected 25 long-term R&D projects (out of 36 proposals) for support under the Center's capital investment program. Funds to be used were allocated under the JFY 1985 budget, which ended on the same date. According to the Center, each project will be provided with amounts ranging from 5 million yen to 210 million yen. The Center will soon enter into negotiations with organizers of each R&D project to work out details of the proposed R&D plans including establishment of the R&D consortia and arrangements for additional financing.

To be eligible for support under the Center's capital investment program, two or more companies are required to jointly establish an R&D company or consortium. Although the Japan Key Technology Center is authorized to contribute up to 70% of the capital required for a consortium's R&D project, the proportion of funds being contributed this first year by the Center is relatively small. This is because the total funds available for this year's contributions by the Center are limited to 2 billion yen.

According to a report in the local press, the total R&D expenditure for any one of the 25 projects is likely to exceed several billion yen. A few larger projects, like the "protein engineering project", will cost even more—say over 30 billion yen in total. According to Mr. Tsutomu Yamaguchi, Director of the Center's General Affairs Department, the Center's JFY 1986 budget for the capital investment program will be increased to 12.5 billion yen.

Among the names listed as participants in the 25 R&D projects, there are only two companies financed by American corporations, i.e. IBM Japan and Nihon DEC. Mr. Yamaguchi pointed out that the Center would welcome applications by foreign firms operating in Japan and would ensure that they would be treated without prejudice in the same way as Japanese applicants. In this connection, he also suggested that the organizer of the "protein engineering project" has been in contact with a few American companies soliciting their participation in the project, even though they are yet to be confirmed as such. Likewise, he suggested that the names of the companies given in the initial list of participants are still subject to change, with additions or deletions before the lists are finalized later in the year.

Proposals for consideration for next year's (JFY 86) support under the Center's capital investment program are due in May of this year.

Listed in the following pages are the 25 projects selected by the Center, including the project title, amount of contribution by the Japan Key Technology Center (JKTC) in the form of capital investment, names of the participating companies/organizations and a brief description of the objectives. The information given is based on material received from Mr. Yamaguchi, Director of the JKTC's General Affairs Department, and translated by NSF/Tokyo.

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[1] See NSF/Tokyo Report Memorandum #91

1. Non-Oxide Glass

(a) Amount of JKTC Contribution: 35 million yen.

(b) Participating Companies and Organizations: Nippon Sheet Glass Co.; HOYA Corporation.

(c) Objectives: To develop a new type of opto-functional glass utilizing chalogens such as selenium and tellerium to achieve a high transmission coefficient for infrared light in wavelengths ranging from 10–15 microns. The new glass to be developed is expected to help increase use of infrared light of such application areas as medical "laser scalpels", remote-sensing and optical memory devices.

2. 2nd Generation Opto-electronic IC's

(a) Amount of JKTC Contribution: 10 million yen.

(b) Participating Companies and Organizations: NEC Corporation; Oki Electric Industrial Co., Ltd.; Sumitomo Electric Industries Ltd.; Toshiba Corporation, and 9 others.

(c) Objectives: Opto-electronic integrated circuits (OEIC) are IC's with optical devices and electronic circuits put together on a single crystal substrate. Whereas the existing OEIC's are operating at a transmission speed of 1 giga-bit per second, the improved process and device technologies to be developed under the project are expected to help raise the transmission speed by one order of magnitude, i.e. to the 10 giga-bits level.

3. Comprehensive Studies on Use of Space Environment

(a) Amount of JKTC Contribution: 75 million yen.

(b) Participating Companies and Organizations: Ishikawajima-Harima Heavy Industries, Co., Ltd.; Toshiba Corporation; NEC Corporation; Hitachi, Ltd. and 2 others.

(c) Objectives: By taking advantage of microgravity environment in space it is planned to establish innovative material processing technologies for applications in electronics, biotechnologies and new material sciences. Included also in the proposed project is the development of various systems and/or apparatus for use in space experiments.

4. Studies on Basic Measurement Technologies for Coherent Light Communication

(a) Amount of JKTC Contribution: 90 million yen.

(b) Participating Companies and Organizations: Yokogawa Hokushin Electric Corporation; ADVANTEST Ltd.; Ando Electric Co., Ltd.; Iwatsu Electric Co., Ltd.; Anritsu Ltd.

(c) Objectives: In recent years, systems based on signals generated by variations in the number of light oscillations, rather than variations in light intensity have been considered useful in increasing capacities of optical communications. To build such systems, however, would require highly coherent lights. As a step towards this end, it is planned to develop, under the proposed project, highly reliable technologies for taking measurement of coherent light losses, light power, frequencies, phase variations, etc.

5. Establishment of Procedures for Gene Munipulation and for Chemical Synthesis of Active Peptides, and Development of Methodologies for Peptide Activity Screening

(a) Amount of JKTC Contribution: 30 million yen.

(b) Participating Companies and Organizations: Meiji Seika Kaisha, Ltd.; DAICEL Chemical Industries, Ltd.

(c) Objectives: To artificially produce peptides with activities identical to those of natural peptides, by resolving structural differences still existing between natural peptides and those produced by either genetic engineering or conventional chemical synthetic processes. To this end, it is planned to develop new processes for liquid-phase chemical synthesis of peptides, and to develop enzymes with specificity for "selective cutting" of peptide sequences.

6. Protein Engineering

(a) Amount of JKTC Contribution: 200 million yen.

(b) Participating Companies and Organizations: Mitsubishi Chemical Industries, Ltd.; Kyowa Hakko Kogyo Co., Ltd.; Takeda Chemical Industries, Ltd.; Toa Nenryo Kogyo K.K.; Toray Industries, Inc.

(c) Objectives: With respect to those proteins governing biotic functions, the proposed project is designed to clarify interrelationships between structures and functions of proteins, so as to make it possible to artificially design and produce proteins

meeting certain specific objectives. The proposed project is expected to greatly vitalize industries in related areas.

7. Advanced Video Information System with Functions for Information Processing

(a) Amount of JKTC Contribution: 80 million yen.

(b) Participating Companies and Organizations: Sumitomo Electric Industries, Ltd.; Fujitsu, Ltd.; Matsushita Electric Industrial Co., Ltd.

(c) Objectives: In order to develop an entirely new information system capable of processing and providing video and audio information as well as database services, it is planned to develop design procedures, information processing methodologies, and to produce equipment and experimental systems for use in evaluating the functions and performance of the target systems.

8. Synchrotron Radiation Application Technologies

(a) Amount of JKTC Contribution: 150 million yen.

(b) Participating Companies and Organization: Mitsubishi Electric Corporation; Toshiba Corporation; NEC Corporation; Hitachi, Ltd., and 9 others.

(c) Objectives: Lights hitting a material would cause the material's chemical bonds and structures to change. This phenomenon is prominent particularly with lights of wavelengths ranging from UV to soft X-rays in vacuum (i.e. 10-8—10-5 cm). Since synchrotron radiation is a source of highly powerful parallel lights with intensity two orders of magnitude higher than that of other light sources in the same wavelength regions, it is planned to take advantage of this feature in order to develop industrial technologies for such applications as super-fine structural processing and photochemical reactions.

9. Development of High Performance Surface Metals

(a) Amount of JKTC Contribution: 35 million yen.

(b) Participating Companies and Organizations: Nippon Kokan K.K.; Kawasaki Steel Corporation; Nippon Steel Corporation; Ishikawajima-Harima Heavy Industries, Co., Ltd., and 13 others.

(c) Objectives: To develop highly functional materials by forming, on a metal surface, layers of various kinds of highly corrosion resistant, heat resistant and abrasion resistant substances. To this end, studies will be made to advance material surface treatment technologies including physical and chemical vapor deposition processes, and others useful in making the functional materials as desired.

10. Electronic Dictionary for Use in Natural Language Processing

(a) Amount of JKTC Contribution: 200 million yen.

(b) Participating Companies and Organizations: Fujitsu Ltd.; Toshiba Corporation; Hitachi, Ltd.; Oki Electric Industrial Co., Ltd.; and 4 others.

(c) Objectives: To develop a prototype of a large-scale electronic dictionary with contents of very broad coverage, such as the one to be required in the processing of natural human languages by computers. To this end, a large volume of language data will be systematically assorted and processed into machine-readable formats.

11. Studies on Human Audio and Visual Sensor Mechanisms

(a) Amount of JKTC Contribution: 130 million yen.

(b) Participating Companies and Organizations: ATR-International (Advanced Telecommunication Research Institute International, Inc.); Nippon Telegraph & Telephone Corporation (NTT); Kokusai Denshin Denwa Co., Ltd. (KDD); The Kansai Electric Power Co., Inc. (KEPCO); IBM Japan, Ltd.; Nihon Digital Equipment Corporation (Nihon DEC); and 35 others.

(c) Objectives: In order to add "human-like" information input/output functions to various information and communication systems, studies will be made to elucidate man's visual and audio sensory mechanisms, with particular emphasis on those parts of the sensory functions considered to have high potential for effective application to communication and information systems. It is planned to study "human functions" first and use the results for the development of improved systems to be added with functions for 3-dimensional image displays, pattern recognition of Kanji characters, as well as functions for the recognition of vowels, consonants, words, etc.

12. Basic Research on Automatic Interpreting Telephones

(a) Amount of JKTC Contribution: 210 million yen.

(b) Participating Companies and Organizations: ATR-International; Nippon Telegraph & Telephone Corporation (NTT); Kokusai Denshin Denwa Co., Ltd. (KDD); Sumitomo Metal Industries, Ltd.; IBM Japan, Ltd.; Nihon Digital Equipment Corporation (Nihon DEC); and 35 others.

(c) Objections: To develop automatic interpreting telephone systems for use in future international communications. In the project, R&D will be carried out to develop such component systems as for voice recognition, machine translation, voice synthesis and database networking; all to be incorporated into the target interpreting telephone systems.

13. Basic Research on Intelligent Communication Systems

(a) Amount of JKTC Contribution: 110 million yen.

(b) Participating Companies and Organizations: ATR-International Nippon Telegraph & Telephone Corporation (NTT); Kokusai Denshin Denwa Co., Ltd. (KDD); Sony Corporation; IBM Japan, Ltd.; Nihon Digital Equipment Corporation (Nihon DEC); and 35 others.

(c) Objectives: To develop technologies making it easy and safe for any laymen to use advanced modern communication systems involving diversified media and high speed information processing functions. To this end, studies will be made to advance technologies for automatic software generation, for simplification of complex access protocols and data retrieval procedures, as well as for automatic generation of databases by use of visual pattern recognition techniques, while insuring economy and safety of the whole systems operations.

14. Basic Research on Optical Microwave Telecommunications

(a) Amount of JKTC Contribution: 105 million yen.

(b) Participating Companies and Organizations: ATR-International Nippon Telegraph & Telephone Corporation (NTT); Kokusai Denshin Denwa Co., Ltd. (KDD); Toshiba Corporation; IBM Japan, Ltd.; Nihon Digital Equipment Corporation (Nihon DEC); and 35 others.

(c) Objectives: To develop technologies for removing interference waves in high speed digital signal processors used in mobile communication systems. To this end, basic studies will be made to develop optical devices for high speed computational processing as well as systems for high speed directional control of antennas. Also, it is planned to develop advanced "active antennas" incorporating optical communication devices and high frequency amplifier circuits, for use in communciations between personal wireless systems via satellites.

15. Integrated Information/Communication Systems for Use in Buildings

(a) Amount of JKTC Contribution: 64 million yen.

(b) Participating Companies and Organizations: Fujitsu Ltd.; Chimizu Construction Co., Ltd.; Taisei Corporation.

(c) Objectives: To develop systems for "intelligent buildings" for use as the next generation office buildings. Specifically, studies will be made to develop integrated information/communication systems for use within buildings by incorporating such functions as communications, building automation and office automation.

16. Voice Activating Associative-Type Information Storage and Communication Systems Operable on Personal Computers.

(a) Amount of JKTC Contribution: 20 million yen.

(b) Participating Companies and Organizations: Carry Lab., Inc.; MAC (Japan) Ltd.; Crystal Soft, Ltd.; T&E Ltd.

(c) Objectives: In order to realize voice recognition on personal computers for voice activated data input/output processes, there will be developed an audio and video image compound analysis system and a simplified inference system. Also to be developed are communication systems for efficient transfer and retrieval of digital and analog compound data of different formats between various computers connected with one another via communication networks.

17. Basic Technologies for the Construction of Joint Backup Communication Networks

(a) Amount of JKTC Contribution: 105 million yen.

(b) Participating Companies and Organizations: System Brain, Ltd.; Seibu Information Center, Ltd.; Dai Nippon Computer Systems, Inc.; BSN Eye-Net, Inc.; Miroku Corporation.

(c) Objectives: To research "backup" systems for telecommunication networking for use in case of failures of telecommunication circuits due to, for example, physical cut-off of wires and cables, or in case of failures of VAN (value-added communication networks). The backup networking system, if built, will eliminate the need for duplicating communication terminals and other equipment hitherto required to prevent sudden cut-off in communications. With the backup system, it would be pos-

sible to have the information being transmitted routed automatically through a backup network, either instantly or with some delay in time.

18. Development of Information Systems for Wholesale Dealer Complexes

(a) Amount of JKTC Contribution: 5 million yen.

(b) Participating Companies and Organizations: Takasaki City Office; Takasaki Wholesalers' Association; Takasaki Chamber of Commerce & Industry; Gunma Bank; and 4 others.

(c) Objectives: To develop coordinated business protocols for use on computer terminals for effective management of wholesale dealers' transactions including receiving and issuing of vouchers, purchase orders, etc. Under the project, it is planned to develop technologies for networking various computer terminals owned by individual wholesale dealers, as well as to develop software required for processing transactions between the dealers through on-line network systems.

19. Experimental Studies for the Development of Kumamoto Information and Guide System

(a) Amount of JKTC Contribution: 10 million yen.

(b) Participating Companies and Organizations: Kumamoto Prefecture Office; Kumamoto Nichi-Nichi Shimbun, Ltd.; Nippon Telegraph & Telephone Corporation (NTT); and 38 others.

(c) Objectives: To develop computerized merchandise databases with information retrieval functions, for, for example, shopping by placing orders through computer terminals. The system will be provided with capabilities for data input/output by IC cards so as to improve efficiency in receiving shopping orders and in collecting the payments. It is also planned to develop interfaces for connections with various other external databases such as those run by newspaper companies.

20. Experimental Studies on Regional Information System to Reinvigorate Rural Areas ("Hometown")

(a) Amount of JKTC Contribution: 70 million yen.

(b) Participating Companies and Organizations: Shimane Prefecture Office; Matuse City Office; San-In Godo Bank; San-In Chuo Television, Ltd.; and 5 others.

(c) Objectives: In order to revitalize industries in Matsue district, studies will be made to develop a videotex system with necessary software and public-use terminals for use, for example in confirming hotel reservations or for access to agricultural information services. Since the new system will be designed to be the district's "information service center", there will be developed a multilateral information system, including databases on such items as "cakes and candies available in the district", and with interfaces for different media of communications including video image processing functions, so as to be linked with any other databases that may be built in the district.

21. Experimental Studies on Integrated Information System for Greater Suwa Teletopia

(a) Amount of JKTC Contribution: 70 million yen.

(b) Participating Companies and Organizations: 6 Cities & Townships in Suwa District; Nagano Prefecture Office; Seiko-Epson Inc.; Okaya Chamber of Commerce & Industry; and 29 others.

(c) Objectives: For the greater Suwa area, covering 3 cities, 2 towns and 1 village, there will be developed a wide-area joint-use database system with information useful in preventing disasters and protecting individuals' privacy. Studies will be made to develop hardware as well as software in order to provide wide-area information services pertaining to tourism and disaster prevention activities, via videotex networks.

22. Experimental Studies on Yamaguchi Triangle Teletopia Information System

(a) Amount of JKTC Contribution: 40 million yen.

(b) Participating Companies and Organizations: Yamaguchi Perfecture Office; Yamaguchi City Office; Bofu City Office; Ogohri Town Office; and 15 others.

(c) Objectives: In order to develop core stations for advanced information service networks in Yamaguchi prefecture, studies will be made to simplify protocols for an easy access to NTT's CAPTAIN (Character and Pattern Telephone Access Information Network) for providing local shopping and other information services including databank service designed specifically for use in social educational programs. Also, efforts will be made to develop systems for providing video image data concerning local industries, and for networking personal computers for easy access to databases to be developed for various industries in the prefecture.

23. Experimental Studies on INF Integrated Information System

(a) Amount of JKTC Contribution: 20 million yen.

(b) Participating Companies and Organizations: Fukushima City Office; Fukushima Prefecture Office; Fukushima Chamber of Commerce & Industry; Nippon Telegraph & Telephone Corporation (NTT); and 158 others.

(c) Objectives: It is planned to develop videotex application systems for providing information services concerning hotels and other local tourist industries centering around hot-spring resort areas, or information on fruit and other local products; all by taking advantage of local characteristics of Fukushima City. Also, efforts will be made to develop an easy data-input and editing system utilizing word-processing functions of personal computers to be used in the INF network.

24. Experimental Studies on Kurume Teletopia Information System

(a) Amount of JKTC Contribution: 30 million yen.

(b) Participating Companies and Organizations: Kurume City Office; Western Lease, Ltd.; Saga Bank; Nishi Nihon Bank; and 39 others.

(c) Objectives: Studies will be made to develop a system to provide information service for local industries by way of NTT's CAPTAIN networking with added capability for the processing of detailed order entries with high accuracy. Also, in order to promote cooperation among different sectors, i.e., industries, universities and government as well as among companies of different industrial areas, it is planned to develop an advanced management information system operable on personal computer networks, with functions for retrieval and processing of data from central databases.

25. Experimental Studies on Kagoshima Videotex System

(a) Amount of JKTC Contribution: 16 million yen.

(b) Participating Companies and Organizations: Kagoshima Prefecture Office; Kagoshima City Office; The Minami Nippon Shimbun, Ltd.; Minami Nippon Broadcasting Co., Ltd.; and 25 others.

(c) Objectives: Studies will be made to develop an electronic "bulleten board" system for exchange of information and opinions of local citizens including young people. Also, in order to "distribute" to schools and individual households study materials and other educational programs, it is planned to build an integrated educational information system. Another part of the project is to develop an information system designed specifically to support local industries; a system with the displayed data easily renewable by simple operation by "electronic cards", and with functions for easy down-loading of data onto an individual's terminals from a central database.

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